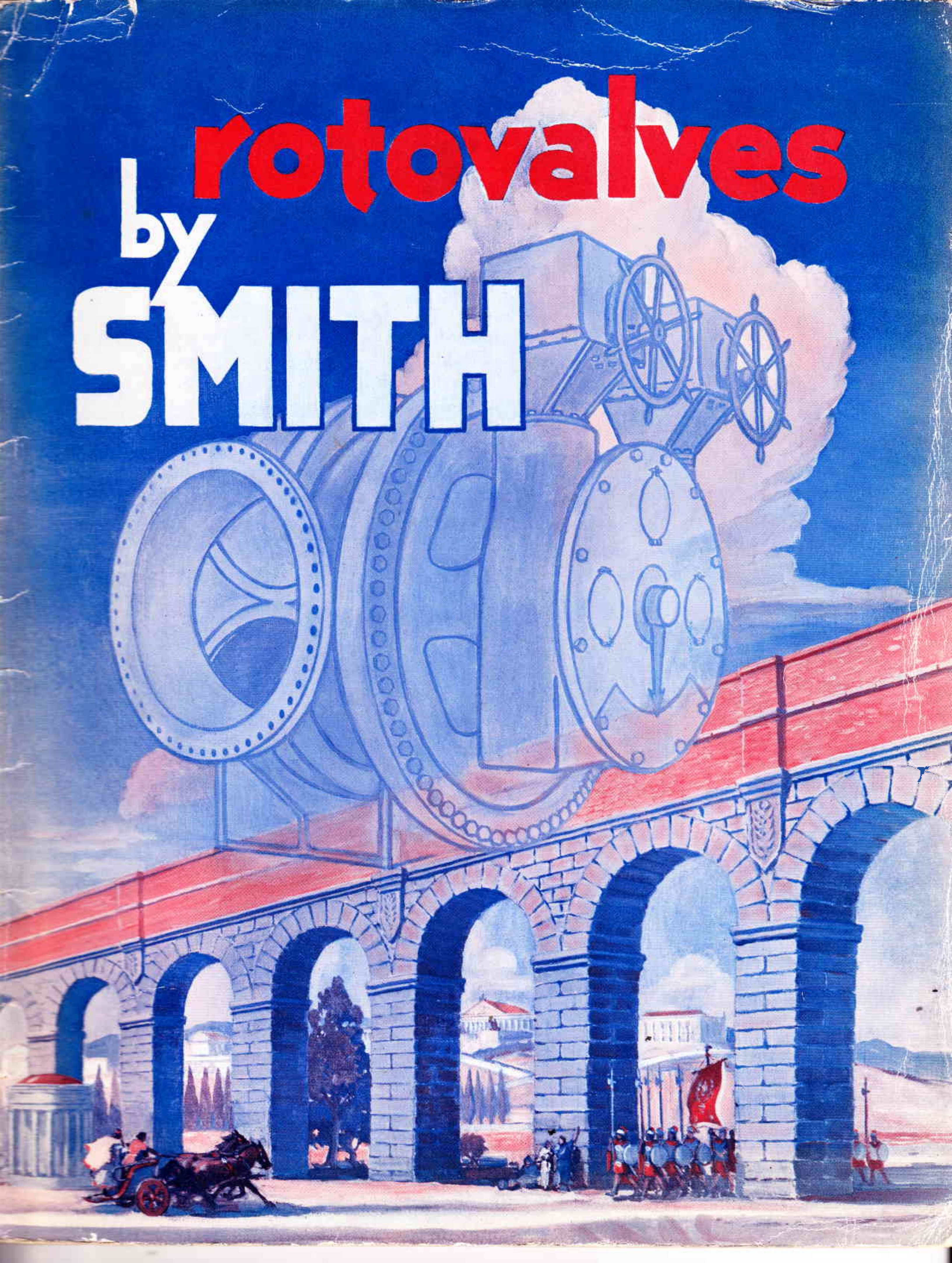
rotovalves
by
SMITH

BULLETIN No. 140

S. MORGAN SMITH COMPANY
YORK, PENNSYLVANIA

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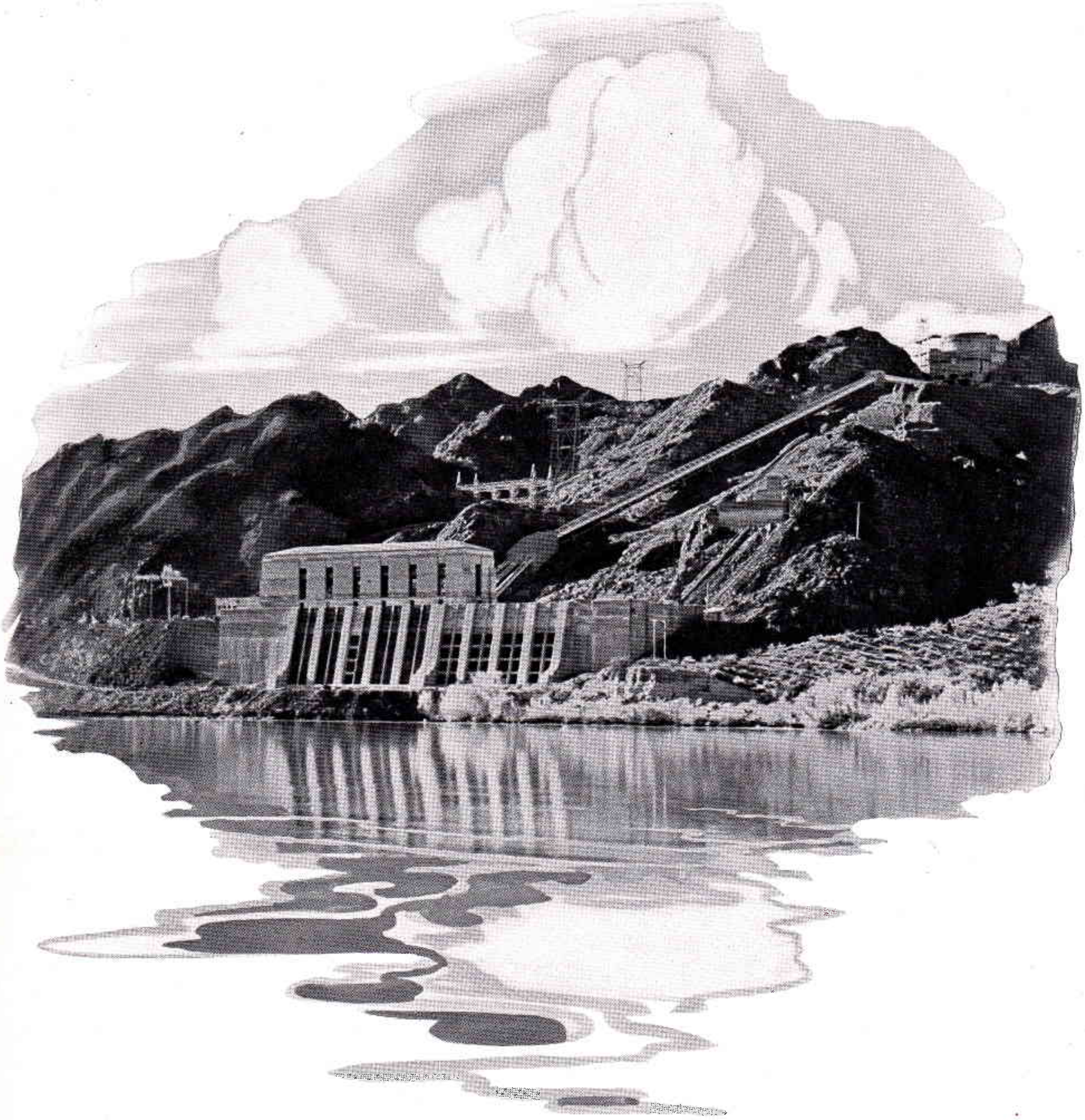
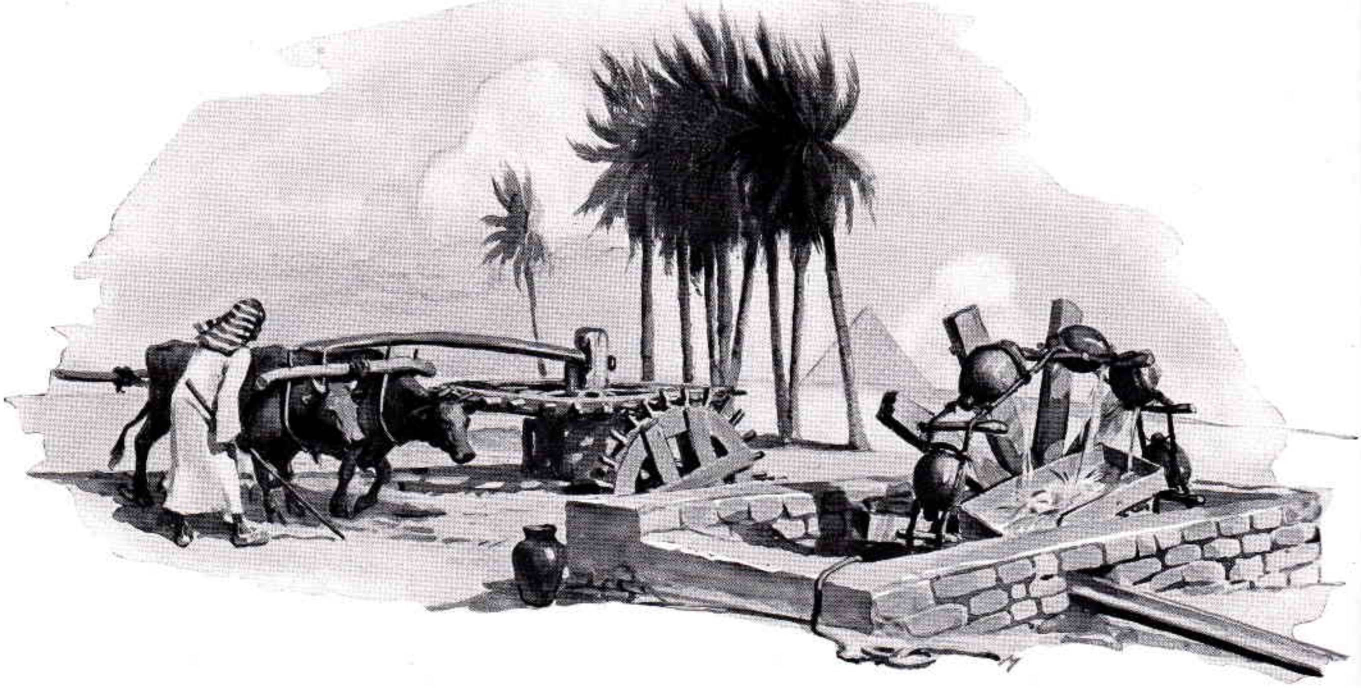


VIEW of the Intake Station at Parker Dam, Arizona. There are five of these pumping stations on the Colorado River Aqueduct all of which are designed for nine pumps of 200 c.f.s. capacity each. The pumps in three of these stations are equipped with automatic check valves of the ROTOVALVE type designed and manufactured by the S. MORGAN SMITH COMPANY.



FOREWORD

TURN back the pages of history to the Egyptians at the time of Rameses II in the 14th Century B.C. and it will be found that these people used many of the basic principles of fluid control that are now so broadly practiced. ℂ The reign of the Pharaohs ended and that of the Caesars began. The Romans absorbed the knowledge of the past and themselves employed those ancient principles to advantage in their vast projects of water supply. The old records of this period reveal that the plug cock was used in their systems of distribution. ℂ Centuries passed, eleven or more, when a darkened world found new life with the revival of the arts and sciences at the beginning of the Renaissance. The progress of all forms of human endeavor during this period of transition was painfully slow. But down through the corridors of time the principle of the conical plug valve has come to us unchanged. ℂ With the advent of the Industrial Rev-

olution in England and on the Continent, development in hydraulics was further pursued and quickly spread to the United States. Long before the close of the 19th Century, spurred by the demands of growing industry, engineers devoted themselves to the further development of this age-old principle. More effective means of operating the plug and new methods of control were vigorously sought. ¶ Current records disclose that more than four hundred attempts have been made in this country alone to produce a satisfactory conical plug valve with its attendant governing devices. Of these many attempts only a few have proven practical. An analysis will disclose that hundreds of thousands of dollars have been spent upon the development of these few. The cost of the unsuccessful attempts is beyond reckoning. ¶ For more than sixty years the S. MORGAN SMITH COMPANY and quality production have had one and the same significance to the hydraulic world. Years of successful achievement, in which inventive thought and mechanical skill were given every opportunity for self-expression, are back of the ROTOVALVES presented in this Bulletin. As such we believe that they mark the peak of progress in valve engineering and design.

INTRODUCTION

THIS Bulletin, in essence, is a Text Book on Conical Plug Valves.

It presents for the first time a summation of the findings, development and available data pertinent to the use of this type of valve in its many and diverse applications. It is our hope that it will be useful, especially to the engineers of the water works and sewerage fields and to such other persons as may be interested in the control of fluids.

Accuracy has been our constant goal when working out all curves, tables and other information. The loss of head curves are based upon averages of a vast amount of data. Therefore, they should be correct within very close limits.

The various material specifications as set forth herein are generally in accordance with present day standards of the American Society for Testing Materials. However, in order to keep pace with progress in the development of new materials or new applications of existing materials, we reserve the right to change any of the aforementioned specifications without notice at our discretion.

The construction and design of the valves mentioned in this bulletin together with their attendant controls are covered by numerous United States patents.

S. MORGAN-SMITH COMPANY

STANDARD

ROTOVALVES

FOR

WATER - AIR - SEWAGE

Manually · Electrically · Hydraulically

OPERATED

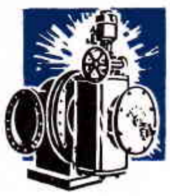
IN

TWO WAY
THREE WAY
FOUR WAY
ANGLE
DESIGN

SIZES

6" to 60" - 125 lb. and 250 lb. STANDARD
FLANGED, HUB or BELL ENDS

ROTOVALVES are particularly adaptable for installation as — STOP VALVES — ALTITUDE VALVES
FLOAT OPERATED VALVES — AUTOMATIC CHECK VALVES
FREE DISCHARGE VALVES — PRESSURE RELIEF VALVES
PRESSURE REDUCING VALVES — RESEATING THROTTLE VALVES
EMERGENCY LINE CHECK VALVES

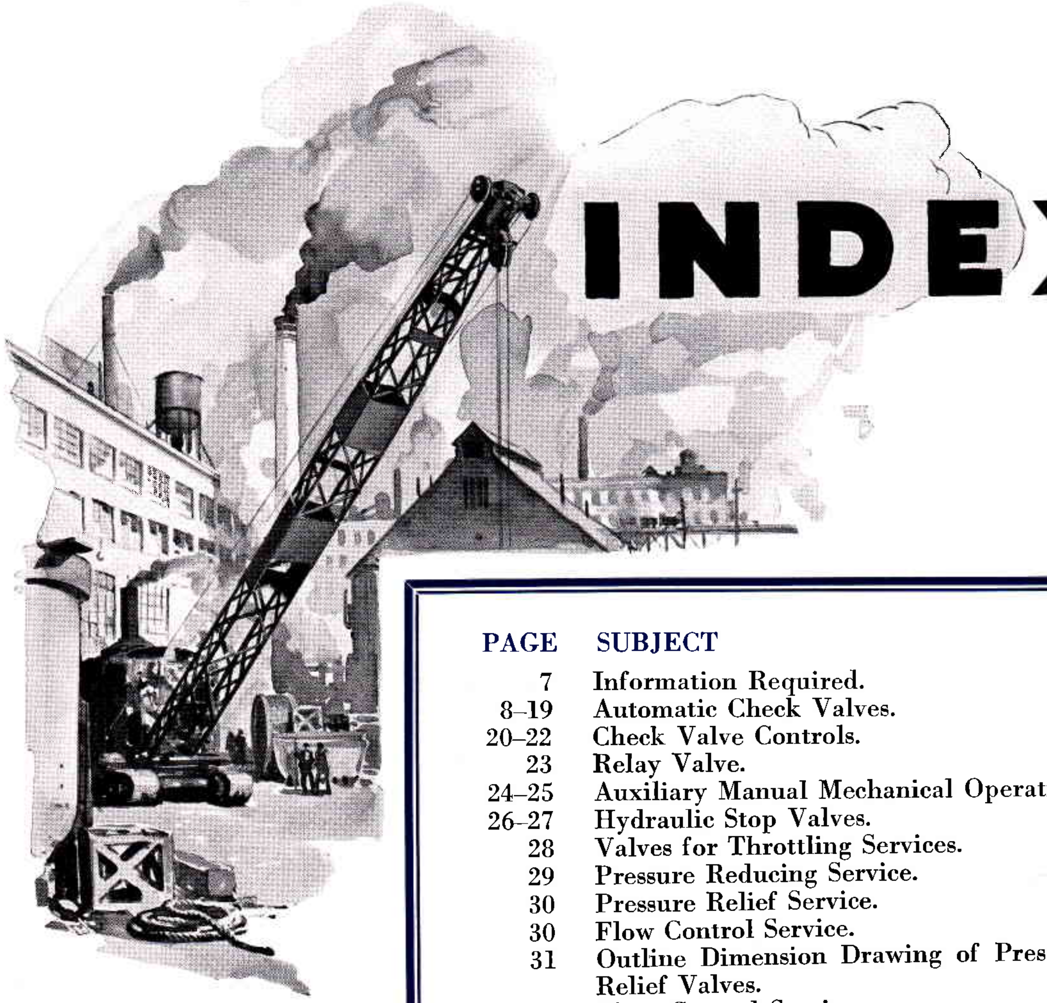


SPECIAL DESIGNS to meet any Operating Condition

ANGLE NEEDLE RELIEF VALVES

4" to 14" STANDARD — 16" to 60" SPECIAL

in BRONZE — IRON or STEEL with FLANGED ENDS



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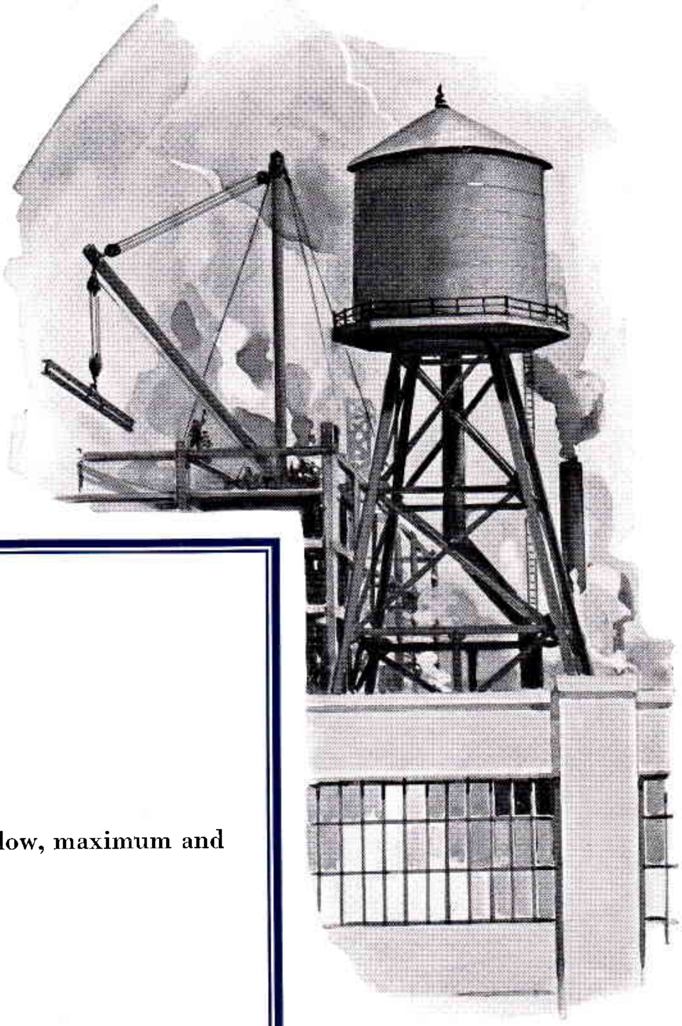
Information Needed *to Properly Serve* YOU



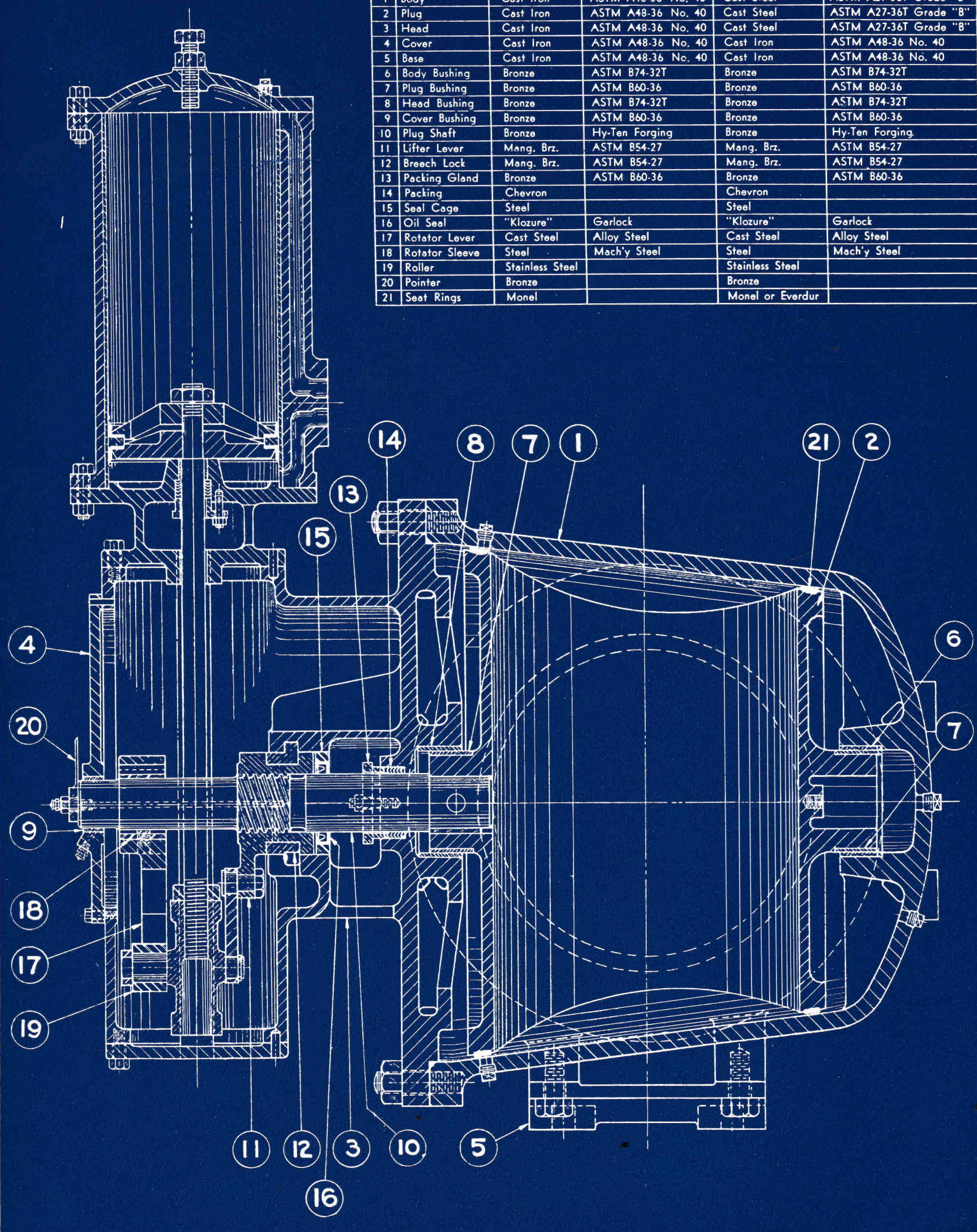
IN ORDER to facilitate and simplify the use of this Bulletin, the various types and applications of valves have been divided into their respective classifications.

A complete knowledge of all field conditions is essential to proper manufacture and design. Therefore, it is important that the following requested information be furnished in as much detail as possible when the installation of equipment is contemplated.

THE INFORMATION REQUIRED:

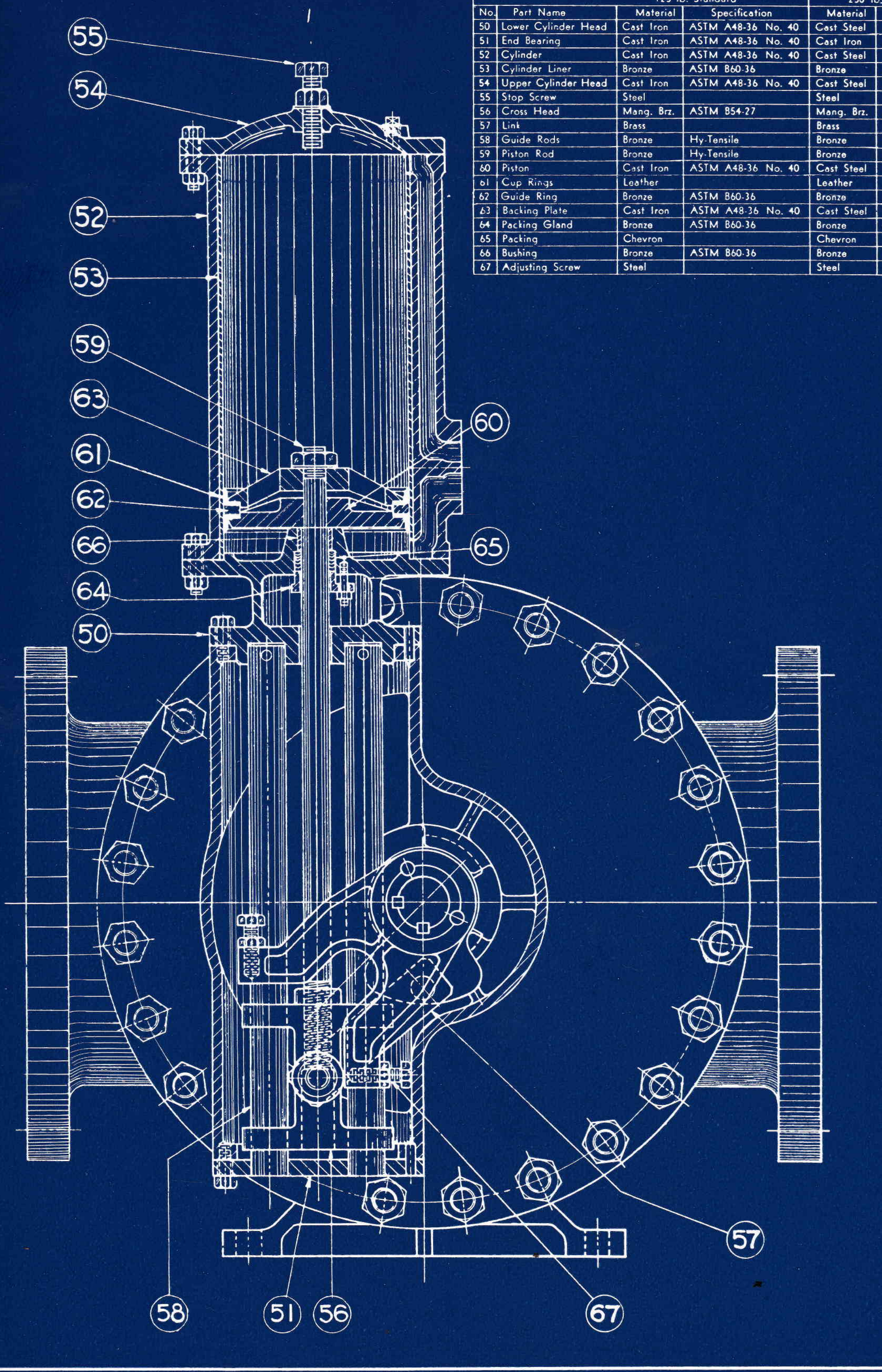
1. Pump discharge sizes and capacities. Rates of flow, maximum and minimum.
2. Working pressures; hydrostatic test pressures.
3. Flange specifications.
4. Type of installation.
5. Pressure available for hydraulic operation.
6. Electrical characteristics, where solenoid or motor operated valves are to be used.
7. All pneumatic characteristics including temperatures in case of check valves for turbo blowers.
8. All requirements to be met in the case of float or altitude valves.
9. Various hydraulic gradients or the maximum and minimum flow characteristics, the location and type of all control stations and stop valves, and a profile of the line in *pipe line work.*
10. Location of points on the profile where proposed emergency line checks are to be used.
11. The diameter, thickness and material of the pipe line.
12. Upstream and downstream pressures, character of service, maximum and minimum variation of pressures and flow in the case of valves for throttling services.
13. Complete description of valve setting and arrangement.
14. Complete and concise description of conditions in cases of special application.

		125 lb. Standard		250 lb. Standard	
No.	Part Name	Material	Specification	Material	Specification
1	Body	Cast Iron	ASTM A48-36 No. 40	Cast Steel	ASTM A27-36T Grade "B"
2	Plug	Cast Iron	ASTM A48-36 No. 40	Cast Steel	ASTM A27-36T Grade "B"
3	Head	Cast Iron	ASTM A48-36 No. 40	Cast Steel	ASTM A27-36T Grade "B"
4	Cover	Cast Iron	ASTM A48-36 No. 40	Cast Iron	ASTM A48-36 No. 40
5	Base	Cast Iron	ASTM A48-36 No. 40	Cast Iron	ASTM A48-36 No. 40
6	Body Bushing	Bronze	ASTM B74-32T	Bronze	ASTM B74-32T
7	Plug Bushing	Bronze	ASTM B60-36	Bronze	ASTM B60-36
8	Head Bushing	Bronze	ASTM B74-32T	Bronze	ASTM B74-32T
9	Cover Bushing	Bronze	ASTM B60-36	Bronze	ASTM B60-36
10	Plug Shaft	Bronze	Hy-Ten Forging	Bronze	Hy-Ten Forging
11	Lifter Lever	Mang. Brz.	ASTM B54-27	Mang. Brz.	ASTM B54-27
12	Breech Lock	Mang. Brz.	ASTM B54-27	Mang. Brz.	ASTM B54-27
13	Packing Gland	Bronze	ASTM B60-36	Bronze	ASTM B60-36
14	Packing	Chevron		Chevron	
15	Seal Cage	Steel		Steel	
16	Oil Seal	"Klozure"	Garlock	"Klozure"	Garlock
17	Rotator Lever	Cast Steel	Alloy Steel	Cast Steel	Alloy Steel
18	Rotator Sleeve	Steel	Mach'y Steel	Steel	Mach'y Steel
19	Roller	Stainless Steel		Stainless Steel	
20	Pointer	Bronze		Bronze	
21	Seat Rings	Monel		Monel or Everdur	

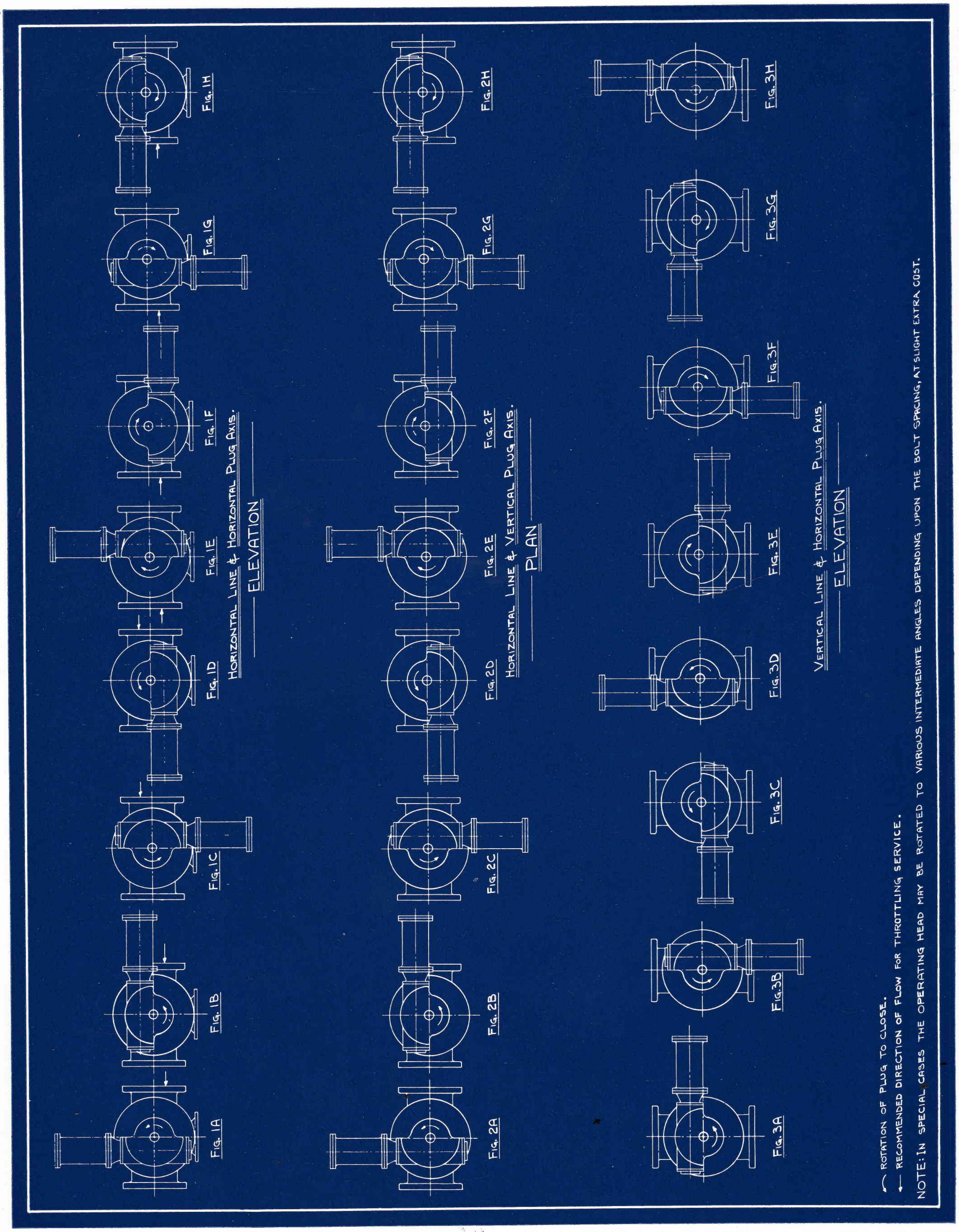


SECTIONAL ASSEMBLY OF STANDARD HYDRAULIC ROTOVALVE.

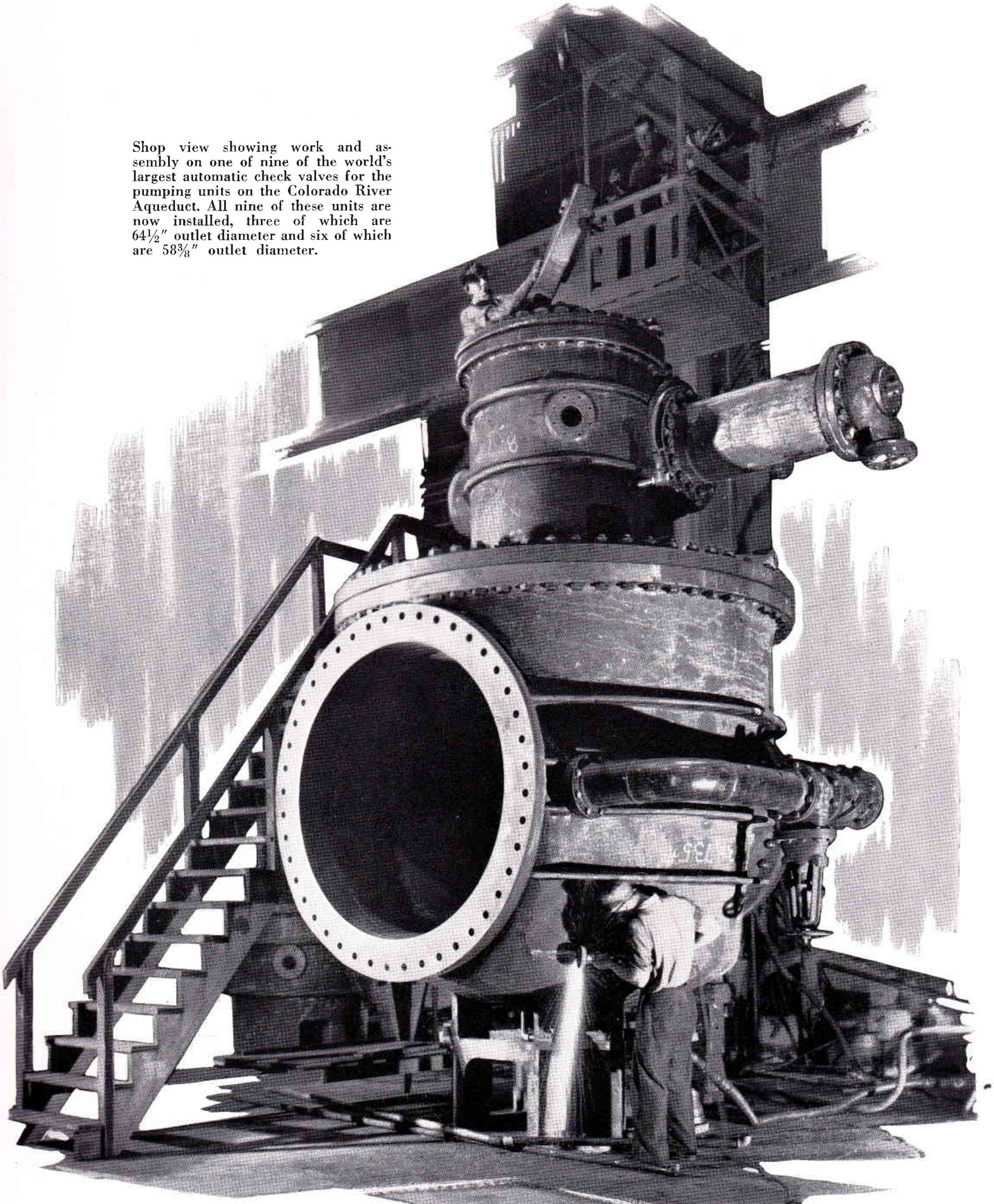
		125 lb. Standard		250 lb. Standard	
No.	Part Name	Material	Specification	Material	Specification
50	Lower Cylinder Head	Cast Iron	ASTM A48-36 No. 40	Cast Steel	ASTM A27-36T Grade "B"
51	End Bearing	Cast Iron	ASTM A48-36 No. 40	Cast Iron	ASTM A48-36 No. 40
52	Cylinder	Cast Iron	ASTM A48-36 No. 40	Cast Steel	ASTM A27-36T Grade "B"
53	Cylinder Liner	Bronze	ASTM B60-36	Bronze	ASTM B60-36
54	Upper Cylinder Head	Cast Iron	ASTM A48-36 No. 40	Cast Steel	ASTM A27-36T Grade "B"
55	Stop Screw	Steel		Steel	
56	Cross Head	Mang. Brz.	ASTM B54-27	Mang. Brz.	ASTM B54-27
57	Link	Brass		Brass	
58	Guide Rods	Bronze	Hy-Tensile	Bronze	Hy-Tensile
59	Piston Rod	Bronze	Hy-Tensile	Bronze	Hy-Tensile
60	Piston	Cast Iron	ASTM A48-36 No. 40	Cast Steel	ASTM A27-36T Grade "B"
61	Cup Rings	Leather		Leather	
62	Guide Ring	Bronze	ASTM B60-36	Bronze	ASTM B60-36
63	Backing Plate	Cast Iron	ASTM A48-36 No. 40	Cast Steel	ASTM A27-36T Grade "B"
64	Packing Gland	Bronze	ASTM B60-36	Bronze	ASTM B60-36
65	Packing	Chevron		Chevron	
66	Bushing	Bronze	ASTM B60-36	Bronze	ASTM B60-36
67	Adjusting Screw	Steel		Steel	



FRONT VIEW ASSEMBLY OF STANDARD HYDRAULIC ROTOVALVE.



STANDARD ARRANGEMENTS OF HYDRAULIC ROTOVALVES.



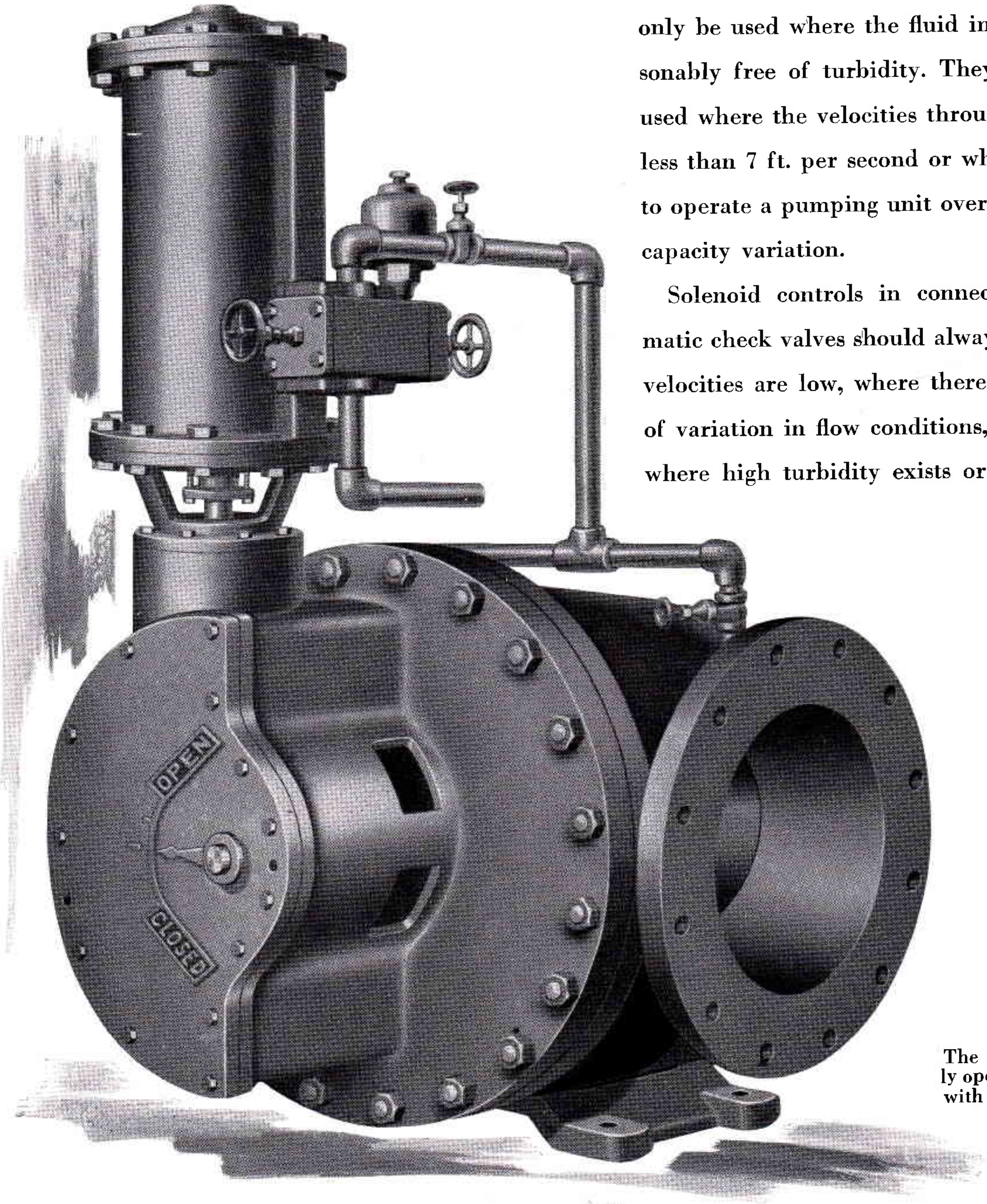
Shop view showing work and assembly on one of nine of the world's largest automatic check valves for the pumping units on the Colorado River Aqueduct. All nine of these units are now installed, three of which are $64\frac{1}{2}''$ outlet diameter and six of which are $58\frac{3}{8}''$ outlet diameter.

AUTOMATIC Check Valves

ALL types of automatic conical check valves are basically a standard hydraulic ROTOVALVE to which is attached the proper control, befitting the class of service under which the valve is to operate. The section drawings on pages 8 and 9 show the general assembly of the standard hydraulic valve, together with parts numbers and materials. The drawing on page 10 shows the various arrangements and possibilities of assembly of any hydraulically operated valve.

Hydraulically controlled check valves designed with diaphragm and pitot tubes should only be used where the fluid in the line is reasonably free of turbidity. They should not be used where the velocities through the valve are less than 7 ft. per second or where it is desired to operate a pumping unit over a wide range of capacity variation.

Solenoid controls in connection with automatic check valves should always be used where velocities are low, where there is a wide range of variation in flow conditions, and in all cases where high turbidity exists or sewage is to be



The standard hydraulically operated ROTOVALVE with solenoid control.

controlled. A separate source of water supply must be provided for control and cylinder operation in all cases where line fluids are not clear.

In the case of automatic check valves for blowers, either type of automatic control can generally be used. However, if the prime mover of the blower is steam operated, diaphragm controls and pitot tubes should be used unless it is possible to make a mechanical electrical interlock between the turbine and the valve control, when a solenoid may be used in the same manner as in the case of a motor driven unit.

Design and Advantages

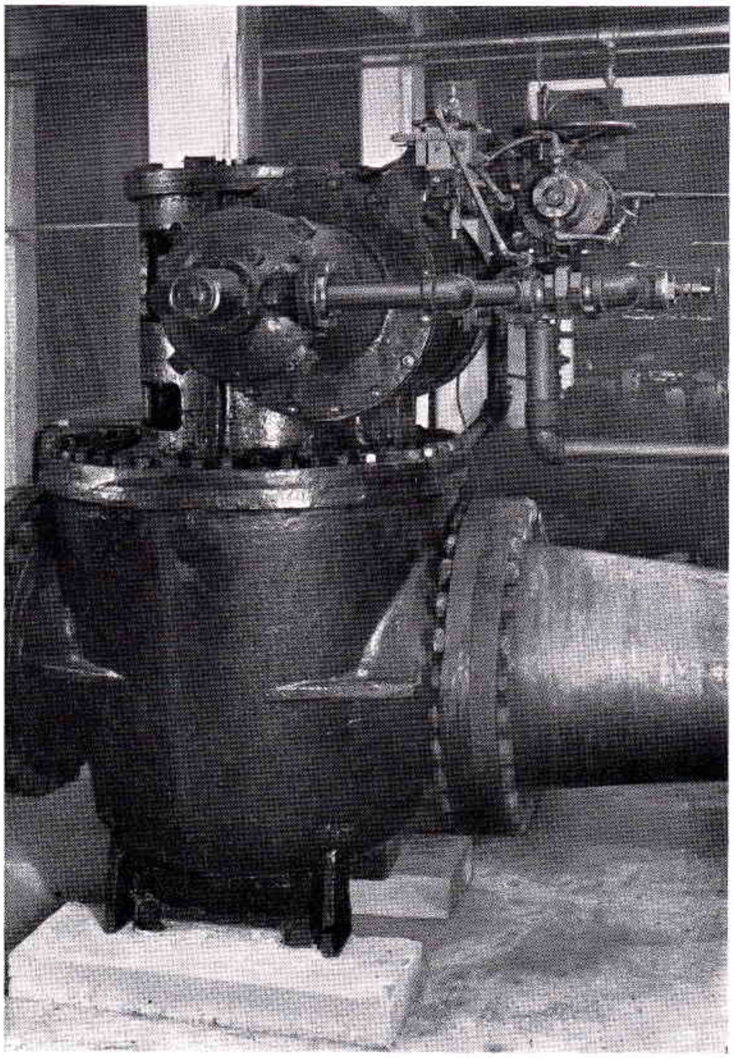
ALL types of ROTOVALVES are designed with ample factors of safety predicated upon an emergency and the most severe conditions under which the valves must operate.

The general design is essentially that of a plug cock. The main parts consist of a casing mounted with either Monel or Everdur seat rings and slightly tapered on its internal surface of revolution, together with a conical plug properly mounted with similar rings which co-operate with the casing seats in either the open or closed position. The plug is provided with a circular orifice of the same diameter as the inlet and outlet connections to the casing. When in the open position, the plug lines up accurately with the casing inlet and outlet connections, resulting in a free, unobstructed passage.

A casing head is provided, upon and in which is located the operating mechanism. To open the valve, this mechanism first lifts the plug axially from the casing seat, rotates it ninety degrees and then returns it axially to its seat in the open position. For closure the reverse operations occur.

All hydraulic check valves may be operated by water, oil or air, as the case and condition may require. All controls used in connection with automatic check valves are designed so that independent timing of opening and closing may be accomplished. Adjustment over a wide range may be obtained without affecting automatic operation.

30″ automatic check valve with solenoid control installed at the East Bottoms Pumping Station, Kansas City, Missouri.



Inherent Factors in the Design of *Automatic* Check Valves

1. Positive control of valve timing. This is of vital importance in controlling water hammer.

2. The curve of area cut-off of the ROTO-VALVE throughout the full stroke of the plug assimilates a parabola and shows a decided retardation of area reduction at the closing end of the stroke. This characteristic also materially aids in the reduction of water hammer, which is shown by the comparison curve on page 86.

3. Free, unobstructed flow results in lower pumping costs due to negligible loss in head. The loss of head through any ROTOVALVE is no greater than through a straight piece of pipe of equal length and diameter.

4. Extremely large trunnions and bearings for mounting the plug are located within the valve casing. These large trunnions and bearings result in greatly reduced bearing pressures.

5. Three-point bearings permit the exact alignment of the plug, body and operating mechanism at all times, lower the working stresses of all parts and assure ease in operation.

6. Reseating in the open position is essential with valves carrying sludge, sewage and raw water.

7. Valve seats are so located in the body that they do not contact the direct flow of the liquid. Hence, pitting, scouring or wire drawing does not occur. Actual wear on the seats only takes place at the time of seating and unseating.

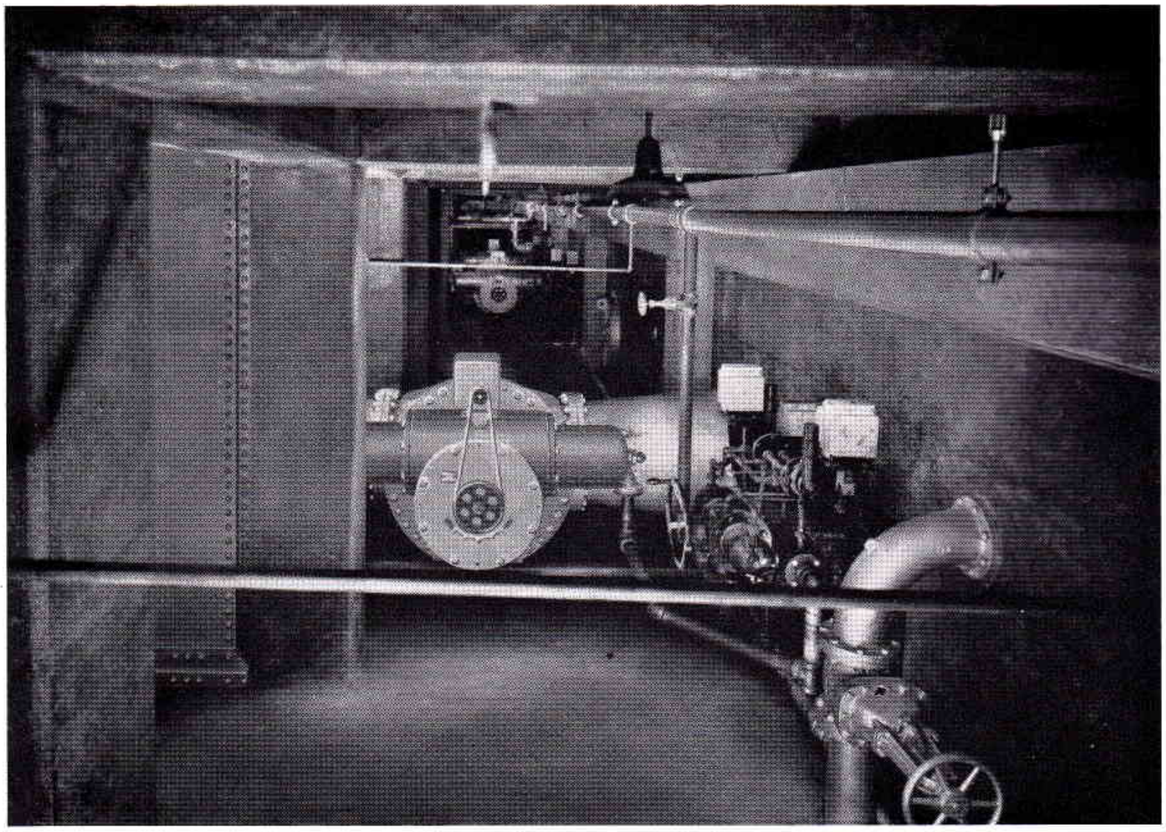
8. ROTOVALVES can be operated very easily on unbalanced pressures without a by-pass, as the entire load is taken on the bearings after unseating.

9. ROTOVALVES may be throttled in any position without creeping open or closed from the position in which they are set.

10. Operating heads of all ROTOVALVES are entirely enclosed so that no foreign material can impair operation. All internal working parts are fully lubricated.

11. ROTOVALVES afford insurance against damage resulting from emergencies. They are dependable.

12. All automatic check valve controls are equipped with manual mechanical means of operation for use in emergencies.



View of the solenoi operated Rotochec valves installed in th Sewage Treatmen Plant, Columbu Ohio. There are i all forty-eight ROTO VALVES installed fo various services i this plant.

Drawings of *Automatic* Check Valves

Page 16 shows an outline drawing with dimensions for all sizes of check valves having a diaphragm control and with the hydraulic cylinder in the vertical position.

On page 17 is an outline dimension drawing of a hydraulic check valve with a solenoid control and vertical hydraulic cylinder.

Page 18 pictures the automatic check valve with diaphragm control and hydraulic cylinder horizontal in an outline dimension drawing.

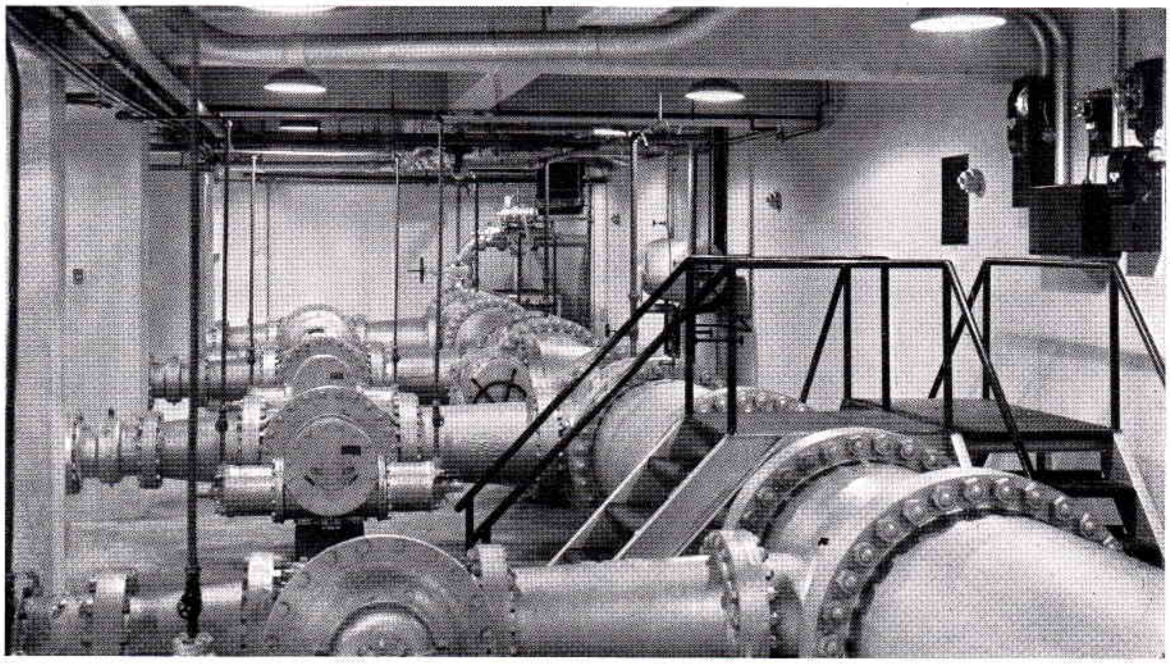
Page 19 is an outline dimension drawing of the automatic check valve, solenoid control and with the hydraulic cylinder horizontal.

Page 20 is a sectional assembly drawing showing parts numbers, materials and dimensions of the solenoid and diaphragm pilots. These pilots are typical standard controls used on all valves from 6″ to 18″, inclusive, and may be used on larger sizes where fast operation is not required.

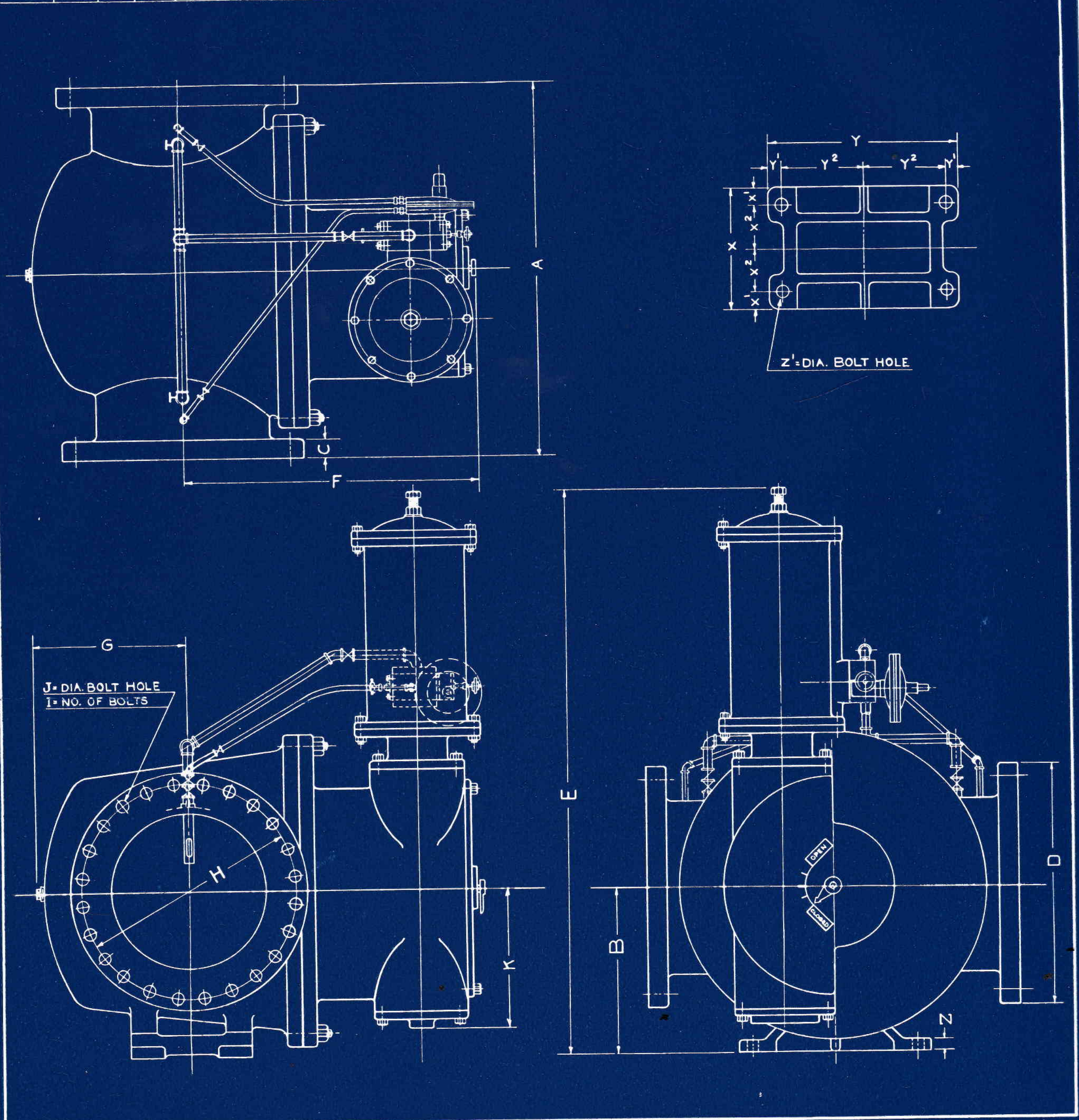
Page 22 shows solenoid and diaphragm controls for all valves 20″ to 48″, inclusive. Controls for standard check valves of 54″ and over are special.

Unusual hydraulic conditions may call for special types of controls. An example would be a composite control for accomplishing differential speeds of plug movement. This applies more particularly to large sizes. However, the actual conditions to be met will govern the recommendations.

Automatic check valves on pump discharges, Western Hills Pumping Station, Cincinnati, Ohio.



	STANDARD 125 LBS. OPERATING PRESSURE																			250 LBS. OPERATING PRESSURE					
Valve Size	A	B	C	D	E	F	G	H	I	J	K	X	X¹	X²	Y	Y¹	Y²	Z	Z¹	A	C	D	H	I	J
6"	23 1/8"	9 1/2"	1"	11"	43"	23 3/4"	7 1/2"	9 1/2"	8	7/8"	11 3/8"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	24"	1 7/16"	12 1/2"	10 5/8"	12	7/8"
8"	23 1/2"	9 1/2"	1 1/8"	13 1/2"	43"	23 3/4"	8 3/4"	11 3/4"	8	7/8"	11 3/8"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	24 1/2"	1 5/8"	15"	13"	12	1"
10"	28 1/8"	12"	1 3/16"	16"	45 1/2"	25 1/4"	11 1/2"	14 1/4"	12	1"	11 3/8"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	29 1/2"	1 7/8"	17 1/2"	15 1/4"	16	1 1/8"
12"	31"	14"	1 1/4"	19"	53 7/8"	28 3/4"	12 1/2"	17"	12	1"	12 7/8"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	32 1/2"	2"	20 1/2"	17 3/4"	16	1 1/4"
14"	35 1/2"	15 1/2"	1 3/8"	21"	55 3/8"	29 3/4"	13 1/4"	18 3/4"	12	1 1/8"	12 7/8"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	37"	2 1/8"	23"	20 1/4"	20	1 1/4"
16"	39"	17 1/8"	1 7/16"	23 1/2"	63 5/8"	33 3/4"	15 1/2"	21 1/4"	16	1 1/8"	15 7/8"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	41"	2 1/4"	25 1/2"	22 1/2"	20	1 3/8"
18"	41 3/4"	19 1/4"	1 9/16"	25"	65 3/4"	34 3/4"	17 3/4"	22 3/4"	16	1 1/4"	15 7/8"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	43 3/8"	2 3/8"	28"	24 3/4"	24	1 3/8"
20"	47"	22"	1 11/16"	27 1/2"	78 1/4"	40"	19 1/2"	25"	20	1 1/4"	20 1/2"	20"	2"	8"	31 1/2"	1 3/4"	14"	1 3/4"	1 3/4"	48 5/8"	2 1/2"	30 1/2"	27"	24	1 3/8"
24"	56"	26"	1 7/8"	32"	82 1/4"	43 3/4"	21 1/4"	29 1/2"	20	1 3/8"	20 1/2"	20"	2"	8"	31 1/2"	1 3/4"	14"	1 3/4"	1 3/4"	57 3/4"	2 3/4"	36"	32"	24	1 5/8"
30"	64"	30 1/2"	2 1/8"	38 3/4"	117 1/2"	57 3/4"	27"	36"	28	1 3/8"	31"	30"	5"	10"	30"	2 1/2"	12 1/2"	1 1/2"	2 1/4"	65 3/4"	3"	43"	39 1/4"	28	1 7/8"
36"	70 1/2"	35"	2 3/8"	46"	122"	61"	28 1/2"	42 3/4"	32	1 5/8"	31"	35 1/2"	4 1/4"	13 1/2"	36"	3"	15"	1 1/2"	2 1/4"	74"	3 3/8"	50"	46"	32	2 1/4"
42"	83 1/4"	43"	2 5/8"	53"	153 1/4"	75"	36"	49 1/2"	36	1 5/8"	37 3/4"	42"	5 1/2"	15 1/2"	42"	4"	17"	2 1/4"	2 5/8"	85 3/8"	3 11/16"	57"	52 3/4"	36	2 1/4"
48"	93"	47 1/2"	2 3/4"	59 1/2"	157 3/4"	78 1/2"	40 1/2"	56"	44	1 5/8"	37 3/4"	54"	6"	21"	54"	6"	21"	2 1/2"	2 5/8"	95 1/2"	4"	65"	60 3/4"	40	2 1/4"
54"	101"	54"	3"	66 1/4"	164 1/4"	81 1/2"	47 1/2"	62 3/4"	44	1 7/8"	50"	54"	6"	21"	54"	6"	21"	2 3/4"	2 3/4"			SPECIAL			
60"	111"	61"	3 1/8"	73"	171 1/4"	84 1/2"	51 1/2"	69 1/4"	52	1 7/8"	50"	60"	9"	21"	60"	9"	21"	2 3/4"	3"			SPECIAL			

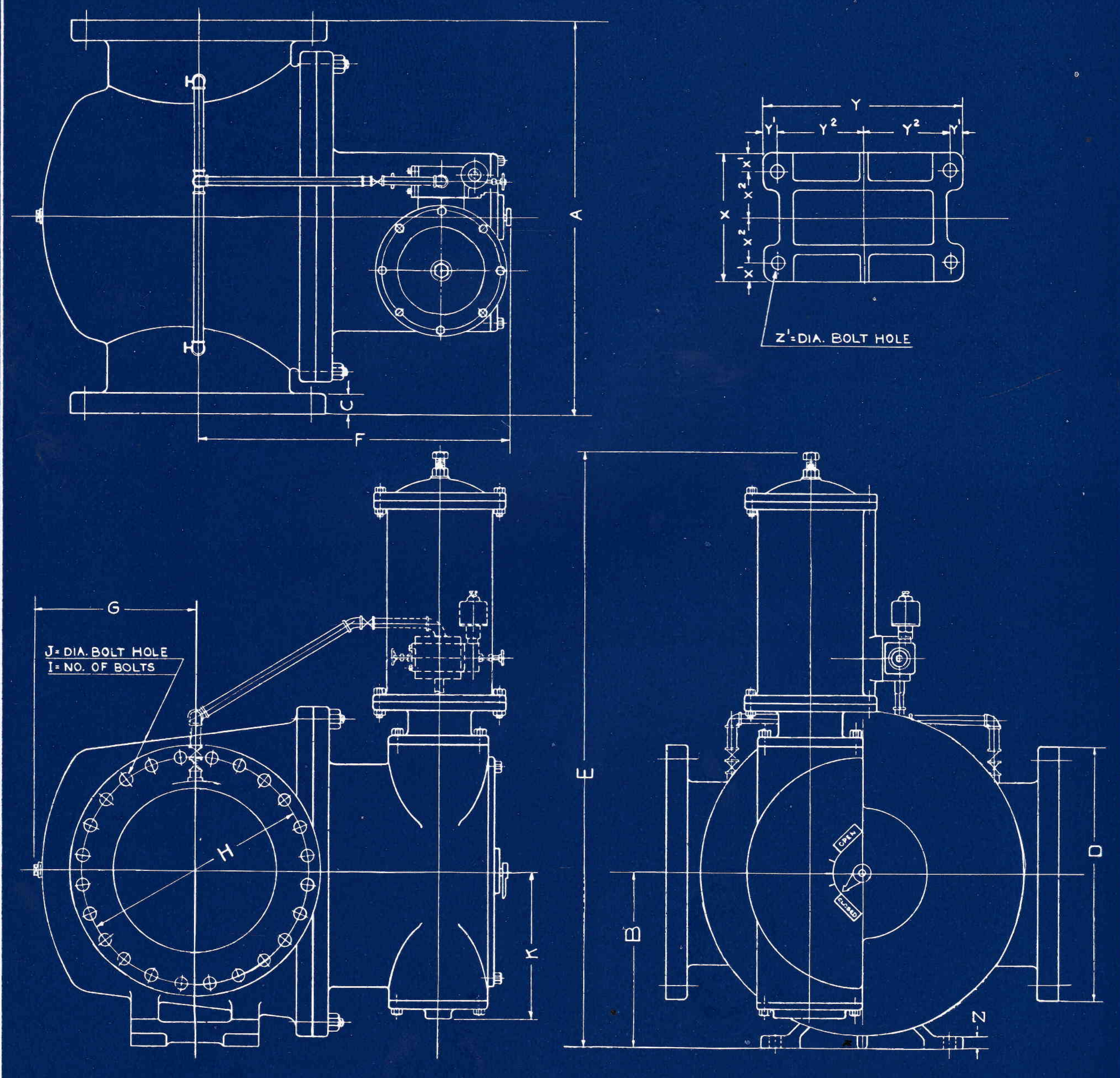


OUTLINE DRAWING OF STANDARD
HYDRAULIC CHECK VALVE WITH DIAPHRAGM CONTROL.

STANDARD 125 LBS. OPERATING PRESSURE

Valve Size	A	B	C	D	E	F	G	H	I	J	K
6"	23 1/8"	9 1/2"	1"	11"	43"	23 3/4"	7 1/2"	9 1/2"	8	7/8"	11 3/8"
8"	23 1/2"	9 1/2"	1 1/8"	13 1/2"	43"	23 3/4"	8 3/4"	11 3/4"	8	7/8"	11 3/8"
10"	28 1/8"	12"	1 3/16"	16"	45 1/2"	25 1/4"	11 1/2"	14 1/4"	12	1"	11 3/8"
12"	31"	14"	1 1/4"	19"	53 7/8"	28 3/4"	12 1/2"	17"	12	1"	12 7/8"
14"	35 1/2"	15 1/2"	1 3/8"	21"	55 3/8"	29 3/4"	13 1/4"	18 3/4"	12	1 1/8"	12 7/8"
16"	39"	17 1/8"	1 7/16"	23 1/2"	63 5/8"	33 3/4"	15 1/2"	21 1/4"	16	1 1/8"	15 7/8"
18"	41 3/4"	19 1/4"	1 9/16"	25"	65 3/4"	34 3/4"	17 3/4"	22 3/4"	16	1 1/4"	15 7/8"
20"	47"	22"	1 11/16"	27 1/2"	78 1/4"	40"	19 1/2"	25"	20	1 1/4"	20 1/2"
24"	56"	26"	1 7/8"	32"	82 1/4"	43 3/4"	21 1/4"	29 1/2"	20	1 3/8"	20 1/2"
30"	64"	30 1/2"	2 1/8"	38 3/4"	117 1/2"	57 3/4"	27"	36"	28	1 3/8"	31"
36"	70 1/2"	35"	2 3/8"	46"	122"	61"	28 1/2"	42 3/4"	32	1 5/8"	31"
42"	83 1/4"	43"	2 5/8"	53"	153 1/4"	75"	36"	49 1/2"	36	1 5/8"	37 3/4"
48"	93"	47 1/2"	2 3/4"	59 1/2"	157 3/4"	78 1/2"	40 1/2"	56"	44	1 5/8"	37 3/4"
54"	101"	54"	3"	66 1/4"	164 1/4"	81 1/2"	47 1/2"	62 3/4"	44	1 7/8"	50"
60"	111"	61"	3 1/8"	73"	171 1/4"	84 1/2"	51 1/2"	69 1/4"	52	1 7/8"	50"

Valve Size	X	X1	X2	Y	Y1	Y2	Z	Z1	250 LBS. OPERATING PRESSURE A	C	D	H	I	J
6"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	24"	1 7/16"	12 1/2"	10 5/8"	12	7/8"
8"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	24 1/2"	1 5/8"	15"	13"	12	1"
10"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	29 1/2"	1 7/8"	17 1/2"	15 1/4"	16	1 1/8"
12"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	32 1/2"	2"	20 1/2"	17 3/4"	16	1 1/4"
14"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	37"	2 1/8"	23"	20 1/4"	20	1 1/4"
16"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	41"	2 1/4"	25 1/2"	22 1/2"	20	1 3/8"
18"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	43 3/8"	2 3/8"	28"	24 3/4"	24	1 3/8"
20"	20"	2"	8"	31 1/2"	1 3/4"	14"	1 3/4"	1 3/4"	48 5/8"	2 1/2"	30 1/2"	27"	24	1 3/8"
24"	20"	2"	8"	31 1/2"	1 3/4"	14"	1 3/4"	1 3/4"	57 3/4"	2 3/4"	36"	32"	24	1 5/8"
30"	30"	5"	10"	30"	2 1/2"	12 1/2"	1 1/2"	2 1/4"	65 3/4"	3"	43"	39 1/4"	28	1 7/8"
36"	35 1/2"	4 1/4"	13 1/2"	36"	3"	15"	1 1/2"	2 1/4"	74"	3 3/8"	50"	46"	32	2 1/4"
42"	42"	5 1/2"	15 1/2"	42"	4"	17"	2 1/4"	2 5/8"	85 3/8"	3 11/16"	57"	52 3/4"	36	2 1/4"
48"	54"	6"	21"	54"	6"	21"	2 1/2"	2 5/8"	95 1/2"	4"	65"	60 3/4"	40	2 1/4"
54"	54"	6"	21"	54"	6"	21"	2 3/4"	2 3/4"			SPECIAL			
60"	60"	9"	21"	60"	9"	21"	2 3/4"	3"			SPECIAL			



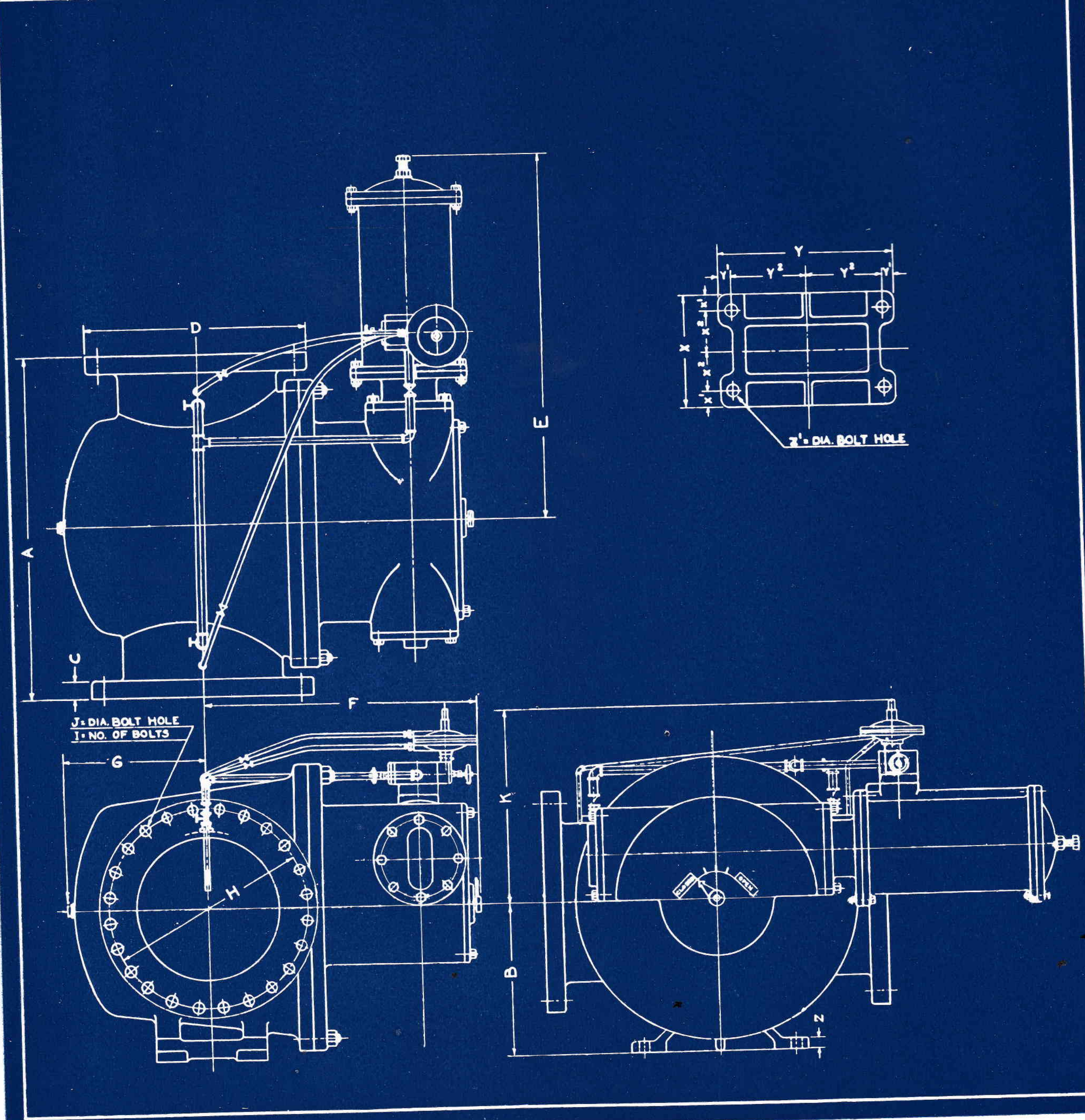
OUTLINE DRAWING OF STANDARD
HYDRAULIC CHECK VALVE WITH SOLENOID CONTROL.

STANDARD 125 LBS. OPERATING PRESSURE

Valve Size	A	B	C	D	E	F	G	H	I	J	K	X	X1	X2	Y	Y1	Y2	Z	Z1
6"	23 1/8"	9 1/2"	1"	11"	33 1/2"	23 3/4"	7 1/2"	9 1/2"	8	7/8"	17 7/8"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"
8"	23 1/2"	9 1/2"	1 1/8"	13 1/2"	33 1/2"	23 3/4"	8 3/4"	11 3/4"	8	7/8"	17 7/8"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"
10"	28 1/8"	12"	1 3/16"	16"	33 1/2"	25 1/4"	11 1/2"	14 1/4"	12	1"	17 7/8"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"
12"	31"	14"	1 1/4"	19"	39 7/8"	28 3/4"	12 1/2"	17"	12	1"	20 3/8"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"
14"	35 1/2"	15 1/2"	1 3/8"	21"	39 7/8"	29 3/4"	13 1/4"	18 3/4"	12	1 1/8"	20 3/8"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"
16"	39"	17 1/8"	1 7/16"	23 1/2"	46 1/2"	33 3/4"	15 1/2"	21 1/4"	16	1 1/8"	23 1/8"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"
18"	41 3/4"	19 1/4"	1 9/16"	25"	46 1/2"	34 3/4"	17 3/4"	22 3/4"	16	1 1/4"	23 1/8"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"
20"	47"	22"	1 11/16"	27 1/2"	56 1/4"	40"	19 1/2"	25"	20	1 1/4"	30 3/4"	20"	2"	8"	31 1/2"	1 3/4"	14"	1 3/4"	1 3/4"
24"	56"	26"	1 7/8"	32"	56 1/4"	43 3/4"	21 1/4"	29 1/2"	20	1 3/8"	30 3/4"	20"	2"	8"	31 1/2"	1 3/4"	14"	1 3/4"	1 3/4"
30"	64"	30 1/2"	2 1/8"	38 3/4"	87"	57 3/4"	27"	36"	28	1 3/8"	39 1/8"	30"	5"	10"	30"	2 1/2"	12 1/2"	1 1/2"	2 1/4"
36"	70 1/2"	35"	2 3/8"	46"	87"	61"	28 1/2"	42 3/4"	32	1 5/8"	39 1/8"	35 1/2"	4 1/4"	13 1/2"	36"	3"	15"	1 1/2"	2 1/4"
42"	83 1/4"	43"	2 5/8"	53"	110 1/4"	75"	36"	49 1/2"	36	1 5/8"	43 5/8"	42"	5 1/2"	15 1/2"	42"	4"	17"	2 1/4"	2 5/8"
48"	93"	47 1/2"	2 3/4"	59 1/2"	110 1/4"	78 1/2"	40 1/2"	56"	44	1 5/8"	43 5/8"	54"	6"	21"	54"	6"	21"	2 1/2"	2 5/8"
54"	101"	54"	3"	66 1/4"	110 1/4"	81 1/2"	47 1/2"	62 3/4"	44	1 7/8"	48 5/8"	54"	6"	21"	54"	6"	21"	2 3/4"	2 3/4"
60"	111"	61"	3 1/8"	73"	110 1/4"	84 1/2"	51 1/2"	69 1/4"	52	1 7/8"	48 5/8"	60"	9"	21"	60"	9"	21"	2 3/4"	3"

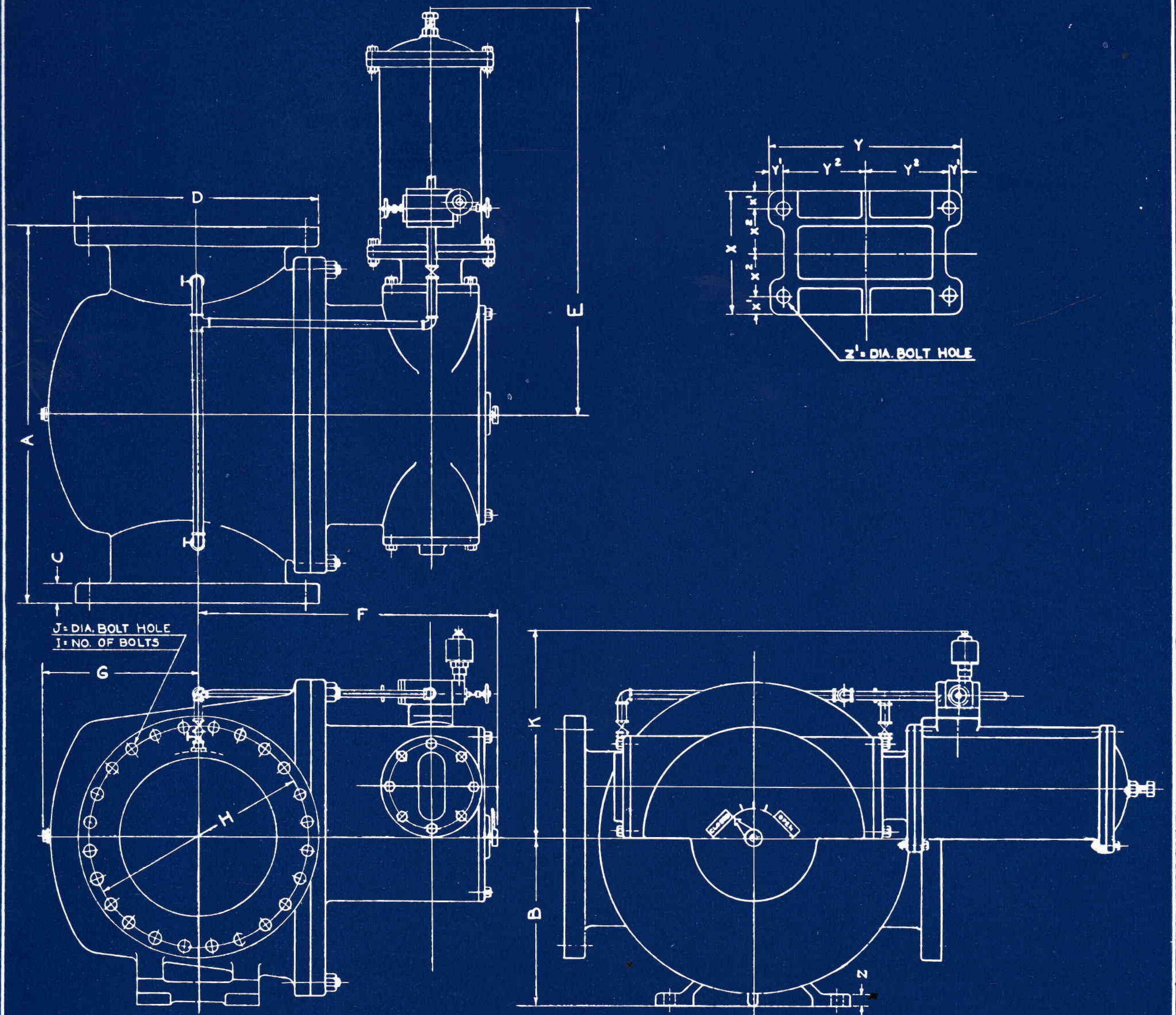
250 LBS. OPERATING PRESSURE

Valve Size	A	C	D	H	I	J
6"	24"	1 7/16"	12 1/2"	10 5/8"	12	7/8"
8"	24 1/2"	1 5/8"	15"	13"	12	1"
10"	29 1/2"	1 7/8"	17 1/2"	15 1/4"	16	1 1/8"
12"	32 1/2"	2"	20 1/2"	17 3/4"	16	1 1/4"
14"	37"	2 1/8"	23"	20 1/4"	20	1 1/4"
16"	41"	2 1/4"	25 1/2"	22 1/2"	20	1 3/8"
18"	43 3/8"	2 3/8"	28"	24 3/4"	24	1 3/8"
20"	48 5/8"	2 1/2"	30 1/2"	27"	24	1 3/8"
24"	57 3/4"	2 3/4"	36"	32"	24	1 5/8"
30"	65 3/4"	3"	43"	39 1/4"	28	1 7/8"
36"	74"	3 3/8"	50"	46"	32	2 1/4"
42"	85 3/8"	3 11/16"	57"	52 3/4"	36	2 1/4"
48"	95 1/2"	4"	65"	60 3/4"	40	2 1/4"
54"			SPECIAL			
60"			SPECIAL			



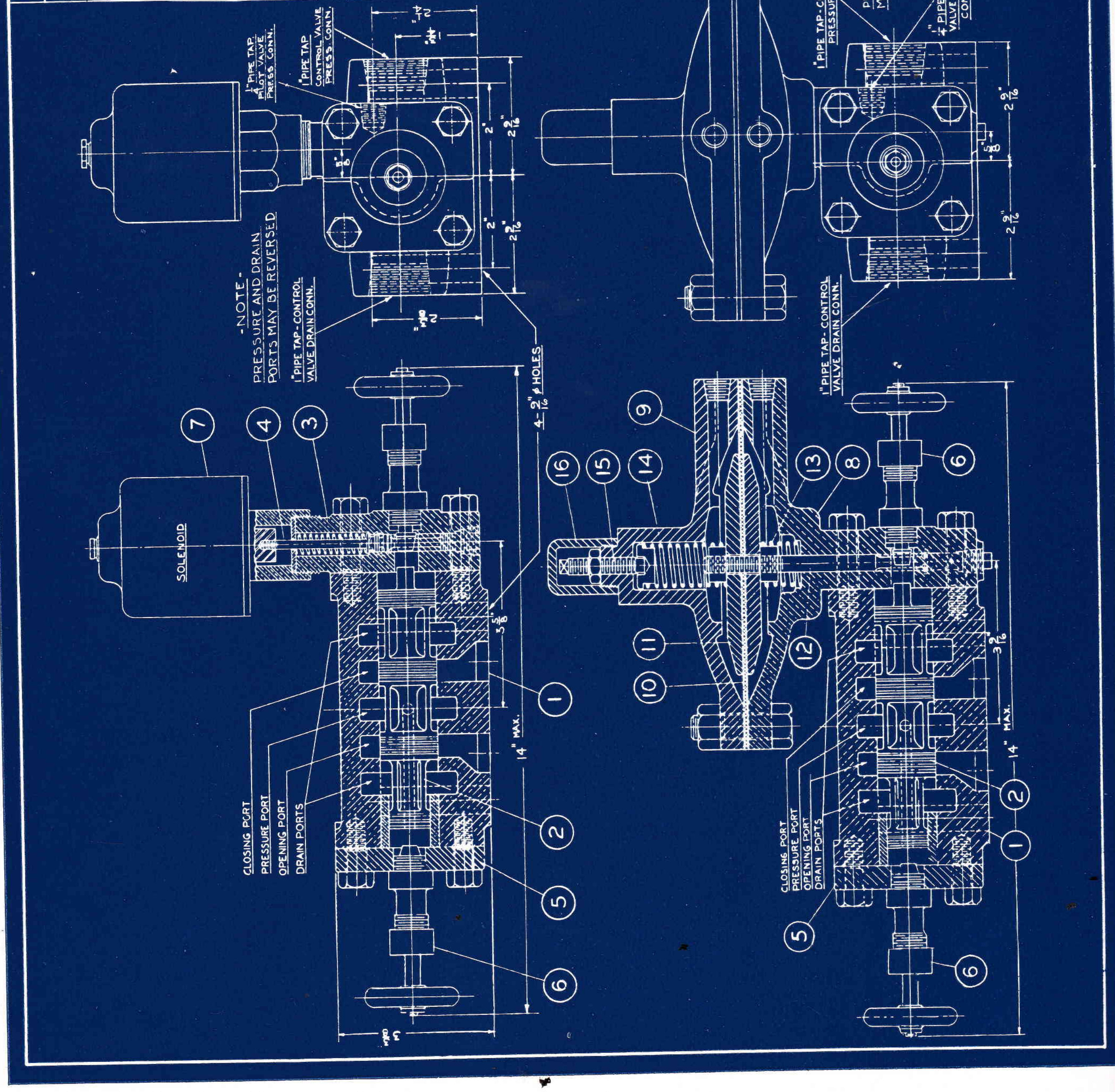
OUTLINE DRAWING OF STANDARD CHECK VALVE, DIAPHRAGM CONTROL, HORIZONTAL MOUNTING.

	STANDARD 125 LBS. OPERATING PRESSURE																			250 LBS. OPERATING PRESSURE					
Valve Size	A	B	C	D	E	F	G	H	I	J	K	X	X1	X2	Y	Y1	Y2	Z	Z1	A	C	D	H	I	J
6"	23 1/8"	9 1/2"	1"	11"	33 1/2"	23 3/4"	7 1/2"	9 1/2"	8	7/8"	17 7/8"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	24"	1 7/16"	12 1/2"	10 5/8"	12	7/8"
8"	23 1/2"	9 1/2"	1 1/8"	13 1/2"	33 1/2"	23 3/4"	8 3/4"	11 3/4"	8	7/8"	17 7/8"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	24 1/2"	1 5/8"	15"	13"	12	1"
10"	28 1/8"	12"	1 3/16"	16"	33 1/2"	25 1/4"	11 1/2"	14 1/4"	12	1"	17 7/8"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	29 1/2"	1 7/8"	17 1/2"	15 1/4"	16	1 1/8"
12"	31"	14"	1 1/4"	19"	39 7/8"	28 3/4"	12 1/2"	17"	12	1"	20 3/8"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	32 1/2"	2"	20 1/2"	17 3/4"	16	1 1/4"
14"	35 1/2"	15 1/2"	1 3/8"	21"	39 7/8"	29 3/4"	13 1/4"	18 3/4"	12	1 1/8"	20 3/8"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	37"	2 1/8"	23"	20 1/4"	20	1 1/4"
16"	39"	17 1/8"	1 7/16"	23 1/2"	46 1/2"	33 3/4"	15 1/2"	21 1/4"	16	1 1/8"	23 1/8"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	41"	2 1/4"	25 1/2"	22 1/2"	20	1 3/8"
18"	41 3/4"	19 1/4"	1 9/16"	25"	46 1/2"	34 3/4"	17 3/4"	22 3/4"	16	1 1/4"	23 1/8"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	43 3/8"	2 3/8"	28"	24 3/4"	24	1 3/8"
20"	47"	22"	1 11/16"	27 1/2"	56 1/4"	40"	19 1/2"	25"	20	1 1/4"	30 3/4"	20"	2"	8"	31 1/2"	1 3/4"	14"	1 3/4"	1 3/4"	48 5/8"	2 1/2"	30 1/2"	27"	24	1 3/8"
24"	56"	26"	1 7/8"	32"	56 1/4"	43 3/4"	21 1/4"	29 1/2"	20	1 3/8"	30 3/4"	20"	2"	8"	31 1/2"	1 3/4"	14"	1 3/4"	1 3/4"	57 3/4"	2 3/4"	36"	32"	24	1 5/8"
30"	64"	30 1/2"	2 1/8"	38 3/4"	87"	57 3/4"	27"	36"	28	1 3/8"	39 1/8"	30"	5"	10"	30"	2 1/2"	12 1/2"	1 1/2"	2 1/4"	65 3/4"	3"	43"	39 1/4"	28	1 7/8"
36"	70 1/2"	35"	2 3/8"	46"	87"	61"	28 1/2"	42 3/4"	32	1 5/8"	39 1/8"	35 1/2"	4 1/4"	13 1/2"	36"	3"	15"	1 1/2"	2 1/4"	74"	3 3/8"	50"	46"	32	2 1/4"
42"	83 1/4"	43"	2 5/8"	53"	110 1/4"	75"	36"	49 1/2"	36	1 5/8"	43 5/8"	42"	5 1/2"	15 1/2"	42"	4"	17"	2 1/4"	2 5/8"	85 3/8"	3 11/16"	57"	52 3/4"	36	2 1/4"
48"	93"	47 1/2"	2 3/4"	59 1/2"	110 1/4"	78 1/2"	40 1/2"	56"	44	1 5/8"	43 5/8"	54"	6"	21"	54"	6"	21"	2 1/2"	2 5/8"	95 1/2"	4"	65"	60 3/4"	40	2 1/4"
54"	101"	54"	3"	66 1/4"	110 1/4"	81 1/2"	47 1/2"	62 3/4"	44	1 7/8"	48 5/8"	54"	6"	21"	54"	6"	21"	2 3/4"	2 3/4"			SPECIAL			
60"	111"	61"	3 1/8"	73"	110 1/4"	84 1/2"	51 1/2"	69 1/4"	52	1 7/8"	48 5/8"	60"	9"	21"	60"	9"	21"	2 3/4"	3"			SPECIAL			



OUTLINE DRAWING OF STANDARD CHECK VALVE, SOLENOID CONTROL, HORIZONTAL MOUNTING.

No.	Part Name	Material	Specification
1	Housing	Bronze	ASTM B60-36
2	Piston	Monel	
3	Pilot Valve Housing	Bronze	ASTM B60-36
4	Pilot Valve Stem	Monel	
5	End Cover	Cast Iron	ASTM A48-36 No. 40
6	Stroke Adjuster	Bronze	
7	Solenoid	To suit current characteristics	
8	Pilot Valve Housing	Bronze	ASTM B60-36
9	Diaphragm Cover	Cast Iron	ASTM A48-36 No. 40
10	Diaphragm	Rubber Composition	
11	Diaphragm Plate	Steel	
12	Pilot Valve Stem	Monel	
13	Equalizing Spring	Bronze	
14	Balancing Spring	Bronze	
15	Adjusting Screw	Bronze	
16	Adjusting Screw Cap	Bronze	



SECTIONAL ASSEMBLY DRAWING OF SOLENOID AND DIAPHRAGM CHECK VALVE CONTROLS.

Check Valve CONTROLS

ILLUSTRATED on page 20 are the solenoid and diaphragm controls used on check valves up to 18″ in diameter. On larger sizes a relay valve, referred to on page 23, is used in conjunction with them. If fast operation is not required, this supplementary mechanism may be omitted.

The solenoid operated control consists of three parts: a solenoid, a three-way valve and a distributing valve. When the main motor switch is thrown in, the solenoid being energized by suitable interlocked contactors, lifts the three-way pilot stem. Lifting the pilot stem admits pressure to the large end of the floating four-way distributing valve piston and moves it to a position of porting, which will cause the main hydraulic piston to rotate the plug to the open position.

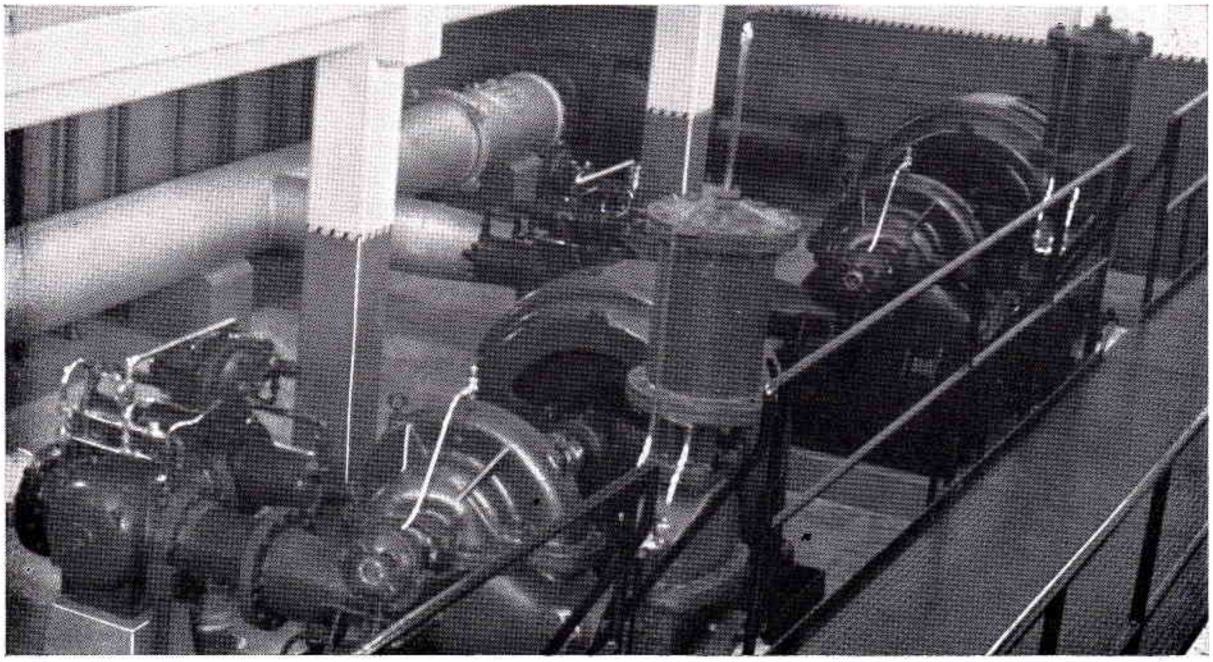
In case of power failure or shutdown, the solenoid is de-energized and allows the three-way valve to drop and assume a position which will exhaust the pressure water on the large end of the floating distributor piston. Since the small end of this piston is always connected to the source of pressure water, it will move to the closing position and thus admit pressure to the closing side of the main hydraulic piston. Independent timing is obtained by operation of the manual screws which limit the travel of the distributor piston. Solenoids are available in all standard control voltages and require 23 watts to operate, with a maximum inrush of 110-volt amperes.

The diaphragm control also consists of three parts: a diaphragm, a three-way valve and a distributing valve. The diaphragm may be made to function in two ways: first, by spring loading and using differential pressures; or second, by spring loading and using pressure on but one side.

The differential method is employed in connection with pitot tubes, one of which is located on the upstream and the other on the downstream side of the valve. The orifices of the tubes are turned in opposite directions. Initial pump pressure against a closed ROTOVALVE is sufficient to overcome the line pressure and spring loading on one side of the diaphragm. After the valve plug opens, the differential velocity head maintains the status quo of the diaphragm as long as sufficient velocity exists in the line. The upward movement of the diaphragm operates the three-way valve and initiates the sequence of operations described in preceding paragraphs. A loss of velocity head moves the diaphragm down to the closed position.

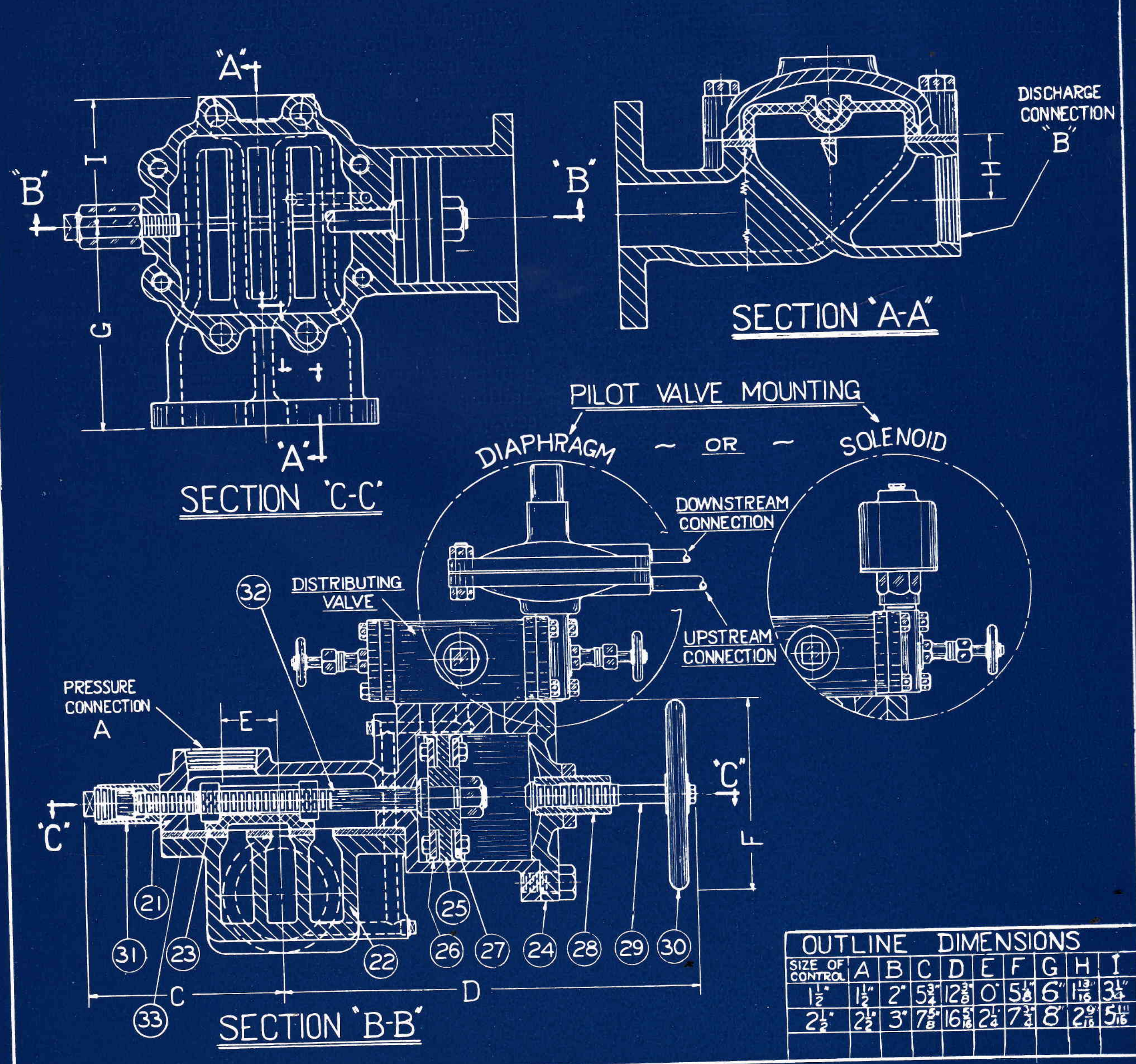
The direct spring loaded diaphragm with pressure on but one side is used only for altitude or other related services.

Diaphragm controls should not be used where the velocities through the valve are less than 7 ft. per second or where it is desired to operate a pumping unit over a large range of capacity, neither should they be used in lines carrying sewage or other fluids having a high degree of turbidity.



Interior view of the Fletcher Drive Pumping Station, City of Los Angeles, California showing two of three ROTOVALVES installed on the pump discharges.

No.	Part Name	Material	Specification	Material	Specification
21	Cylinder Housing	Cast Iron	ASTM A48-36 No. 40	Cast Steel	ASTM A27-36T Grade "B"
22	Body	Cast Iron	ASTM A48-36 No. 40	Cast Steel	ASTM A27-36T Grade "B"
23	"D" Slide	Monel		Monel	
24	Cylinder Cover	Cast Iron	ASTM A48-36 No. 40	Cast Steel	ASTM A27-36T Grade "B"
25	Piston	Bronze	ASTM B60-36	Bronze	ASTM B60-36
26	Cup Rings	Leather		Leather	
27	Backing Plates	Steel		Steel	
28	Adjusting Sleeve	Bronze		Bronze	
29	Manual Closing Stem	Bronze		Bronze	
30	Handwheel	Cast Iron	ASTM A48-36 No. 40	Cast Iron	ASTM A48-36 No. 40
31	Stop Nut	Bronze		Bronze	
32	"D" Slide Stem	Steel		Steel	
33	Bearing Plate	Bronze	S.A.E. No. 63	Bronze	S.A.E. No. 63



OUTLINE DIMENSIONS									
SIZE OF CONTROL	A	B	C	D	E	F	G	H	I
1 1/2"	1 1/2"	2"	5 3/4"	12 3/8"	0"	5 1/8"	6"	1 13/16"	3 1/4"
2 1/2"	2 1/2"	3"	7 5/8"	16 5/16"	2 1/4"	7 3/4"	8"	2 9/16"	5 11/16"

STANDARD DIAPHRAGM AND SOLENOID
CHECK VALVE CONTROLS WITH RELAY ATTACHED.

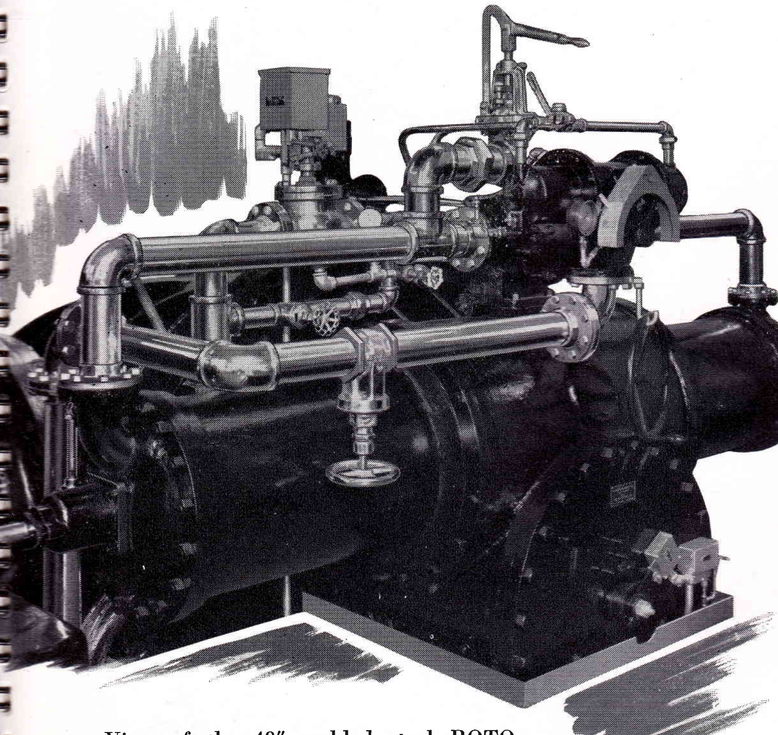
Relay Valve

THE relay valve used on ROTOVALVES 20″ in diameter or larger where fast operation is required is shown on page 22.

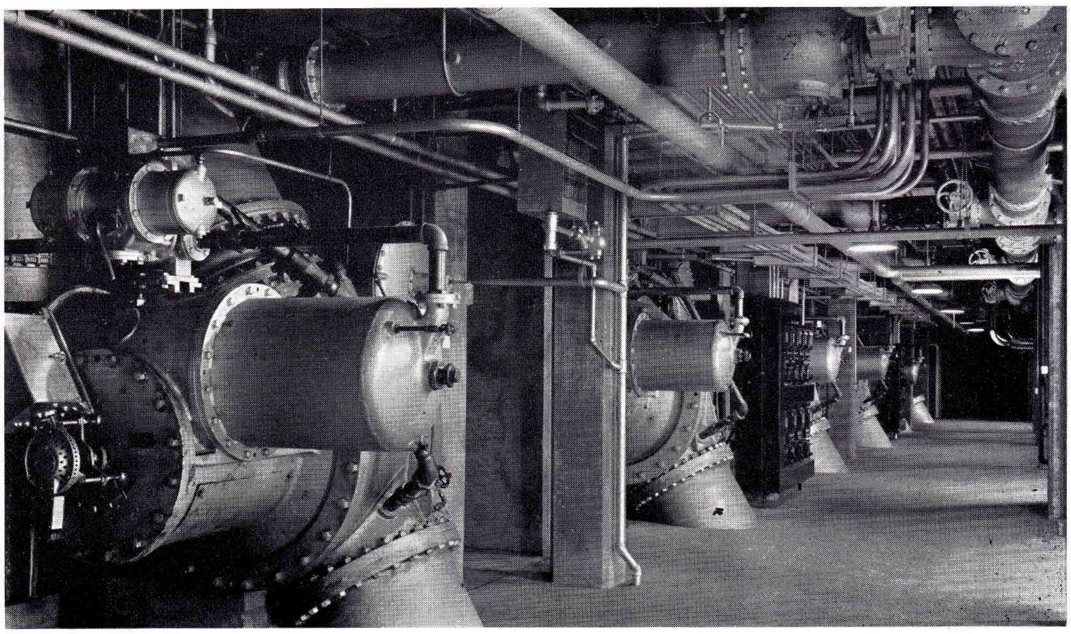
It is controlled by a solenoid or diaphragm operated pilot as described on page 21. Instead of acting directly on the main hydraulic piston, the pilot actuates the power piston of the relay valve. This piston moves a "D"-slide, four-way valve in such a manner as to admit pressure water to the opening or closing side of the main cylinder, exhausting the opposite end of the cylinder and thus causing the main valve to open or close, as directed.

The purpose of a relay valve is to amplify the operations of the pilot valve so that the main valve may be made to operate faster. The rate of opening and closing time may be controlled independently by means of the adjusting screws at each end of the mechanism. A handwheel is provided to move the "D"-slide valve to the closing position without affecting the timing adjustment.

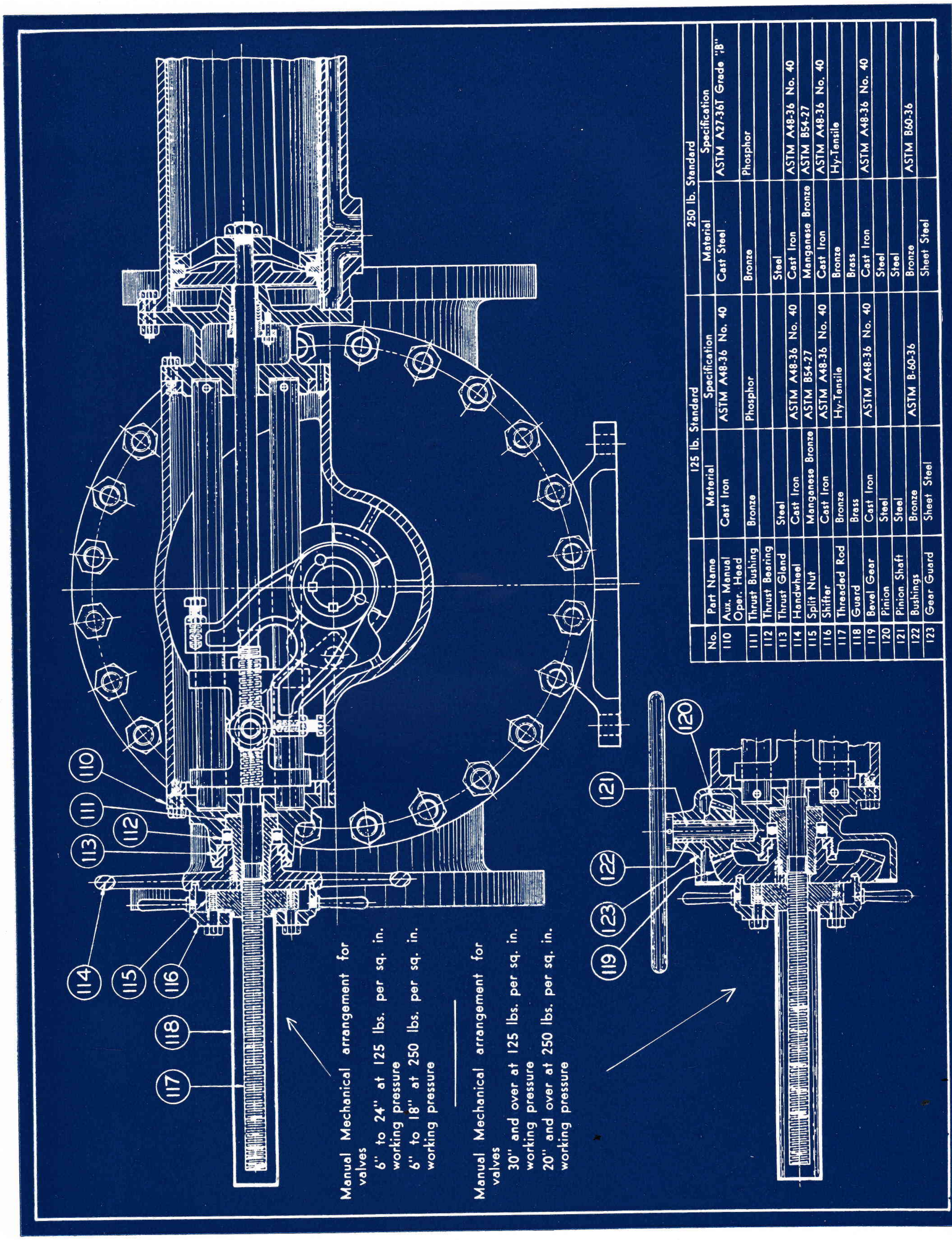
Unusual operating conditions are sometimes encountered. By means of the addition of an auxiliary pilot and suitable electrical interlocks and limit switches, independent slow opening and closing of the main valve may be obtained. The relay valve will function under either normal or emergency conditions, as desired, to accomplish fast closure through any portion or all of the stroke of the large valve.



View of the 48″ welded steel ROTOVALVE with relay control installed in the pumping station of the new Filtration Plant, City of Milwaukee, Wisconsin. There are two 20″, four 36″ and one 48″ Rotocheck valves installed in this plant.



Installation of 30″ and 36″ diaphragm controlled ROTOVALVES on the discharge of the turbo blowers at the Easterly Sewage Treatment Plant, Cleveland, Ohio. These valves are pneumatically operated.



		125 lb. Standard		250 lb. Standard	
No.	Part Name	Material	Specification	Material	Specification
110	Aux. Manual Oper. Head	Cast Iron	ASTM A48-36 No. 40	Cast Steel	ASTM A27-36T Grade "B"
111	Thrust Bushing	Bronze	Phosphor	Bronze	Phosphor
112	Thrust Bearing				
113	Thrust Gland	Steel		Steel	
114	Handwheel	Cast Iron	ASTM A48-36 No. 40	Cast Iron	ASTM A48-36 No. 40
115	Split Nut	Manganese Bronze	ASTM B54-27	Manganese Bronze	ASTM B54-27
116	Shifter	Cast Iron	ASTM A48-36 No. 40	Cast Iron	ASTM A48-36 No. 40
117	Threaded Rod	Bronze	Hy-Tensile	Bronze	Hy-Tensile
118	Guard	Brass		Brass	
119	Bevel Gear	Cast Iron	ASTM A48-36 No. 40	Cast Iron	ASTM A48-36 No. 40
120	Pinion	Steel		Steel	
121	Pinion Shaft	Steel		Steel	
122	Bushings	Bronze	ASTM B-60-36	Bronze	ASTM B60-36
123	Gear Guard	Sheet Steel		Sheet Steel	

SECTIONAL DRAWING OF AUXILIARY MECHANICAL MANUAL OPERATING MECHANISMS.

Auxiliary Manual
Mechanical Operation

IN certain installations it is desirable to provide a mechanical method of operating the ROTO-VALVE in addition to the hydraulic means. This is accomplished by attaching a supplementary mechanism to the operating head. Two types of such a mechanism are illustrated on page 24.

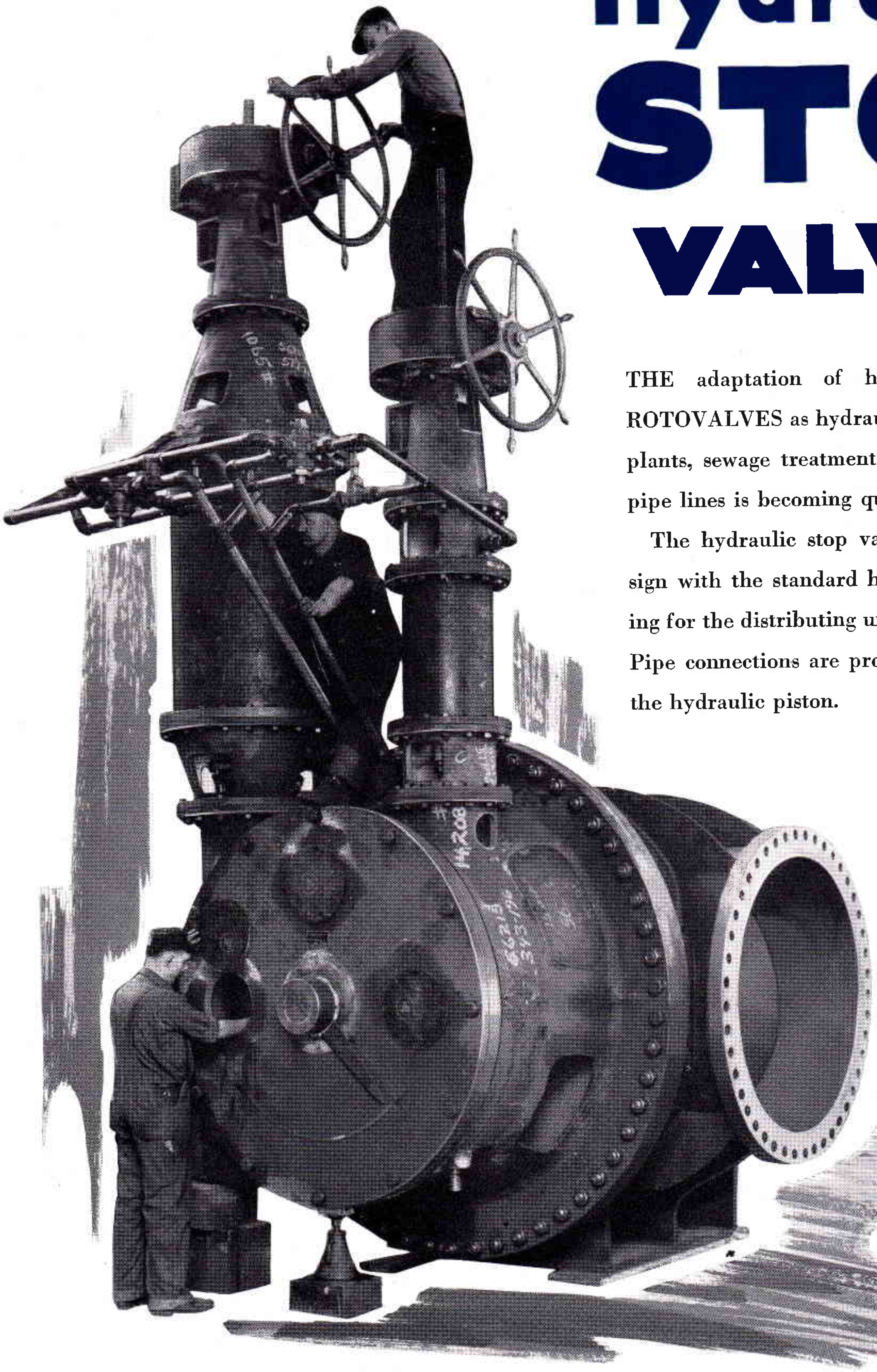
Operation is achieved by engaging a split nut with the manual operating stem and crosshead. Before manual force is applied, the hydraulic controls should be placed in the same position as the direction of movement desired. If they are not, water locking of the hydraulic cylinder will prohibit movement. When manual operation is completed, the split nut must be disengaged.

Either of these extra mechanisms are obtainable at an additional charge.

The mechanism with the handwheel directly connected to the split nut is used on valves up to 24″ at 125 lbs. pressure and up to 18″ at 250 lbs. pressure. Above these limits, gear reductions as illustrated are necessary.

Interior view of the pump room in the new Filtration Plant, City of Milwaukee, Wisconsin.

Hydraulic STOP VALVES



THE adaptation of hydraulically operated ROTOVALVES as hydraulic stop valves in filter plants, sewage treatment plants, penstocks and pipe lines is becoming quite universal.

The hydraulic stop valve is identical in design with the standard hydraulic check excepting for the distributing unit which is eliminated. Pipe connections are provided for operation of the hydraulic piston.

Shop view of a 54″ combination manual and hydraulic reseating stop valve for the Long Valley Project, City of Los Angeles, California. The body and plug of this valve are constructed of electrically welded stainless clad steel. Provision is also made for motor operation.

Section drawings illustrating all parts and materials are shown on pages 8 and 9.

Various assemblies of hydraulic valves are referred to on page 10.

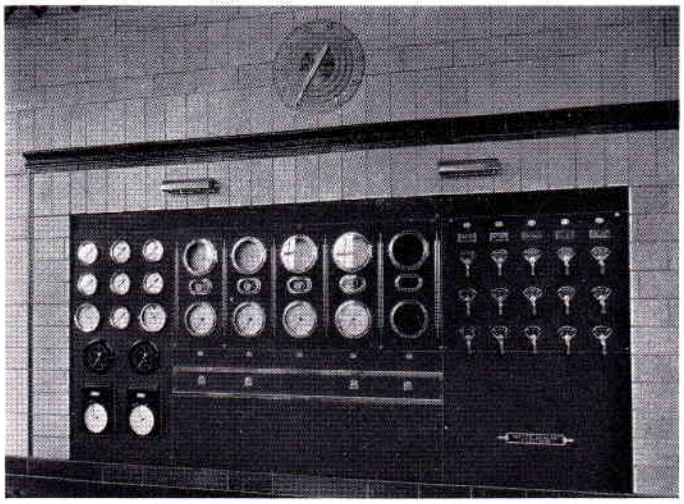
General outline drawings showing all dimensions are covered on pages 16 to 19, inclusive.

Stop valves embodying the features of auxiliary mechanical manual operation in addition to hydraulic means are referred to in the drawing found on page 24.

Hydraulic stop valves are often operated by four-way valves mounted on filter operating tables.

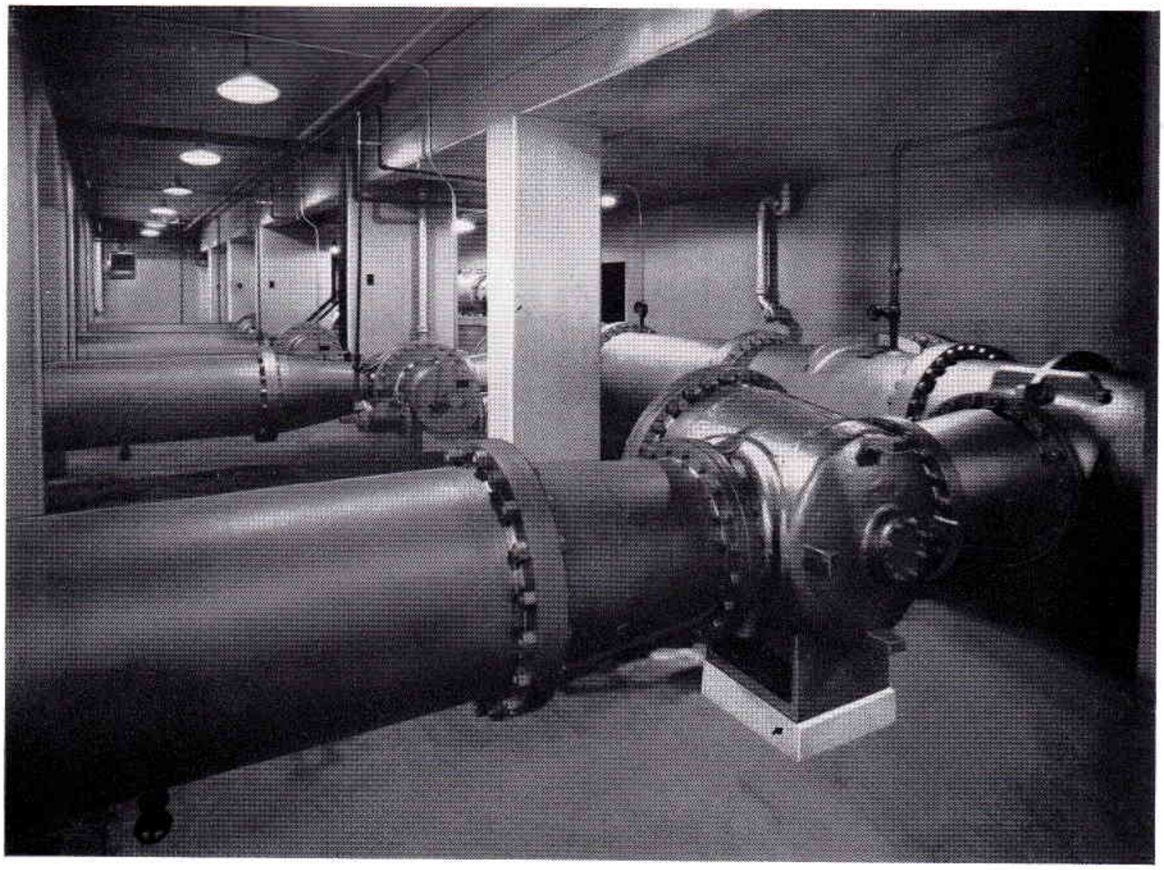
They may be connected to manual hydraulic floor stands or to any hydraulic distributing valve which is motor, solenoid or diaphragm operated from a remote location. Information concerning standard hydraulic floor stands will be found on pages 66 and 67.

All hydraulic stop valves can be operated by water or oil.



Remote valve control and instrument board, Western Hills Pumping Station, Cincinnati, Ohio.

Remote controlled hydraulic stop valves, Western Hills Pumping Station, Cincinnati, Ohio.



VALVES for Throttling Services

THROTTLING services are divided into the following four general classifications:

1. Pressure reducing service.
2. Pressure relief service.
3. Flow control service.
4. Float control service.

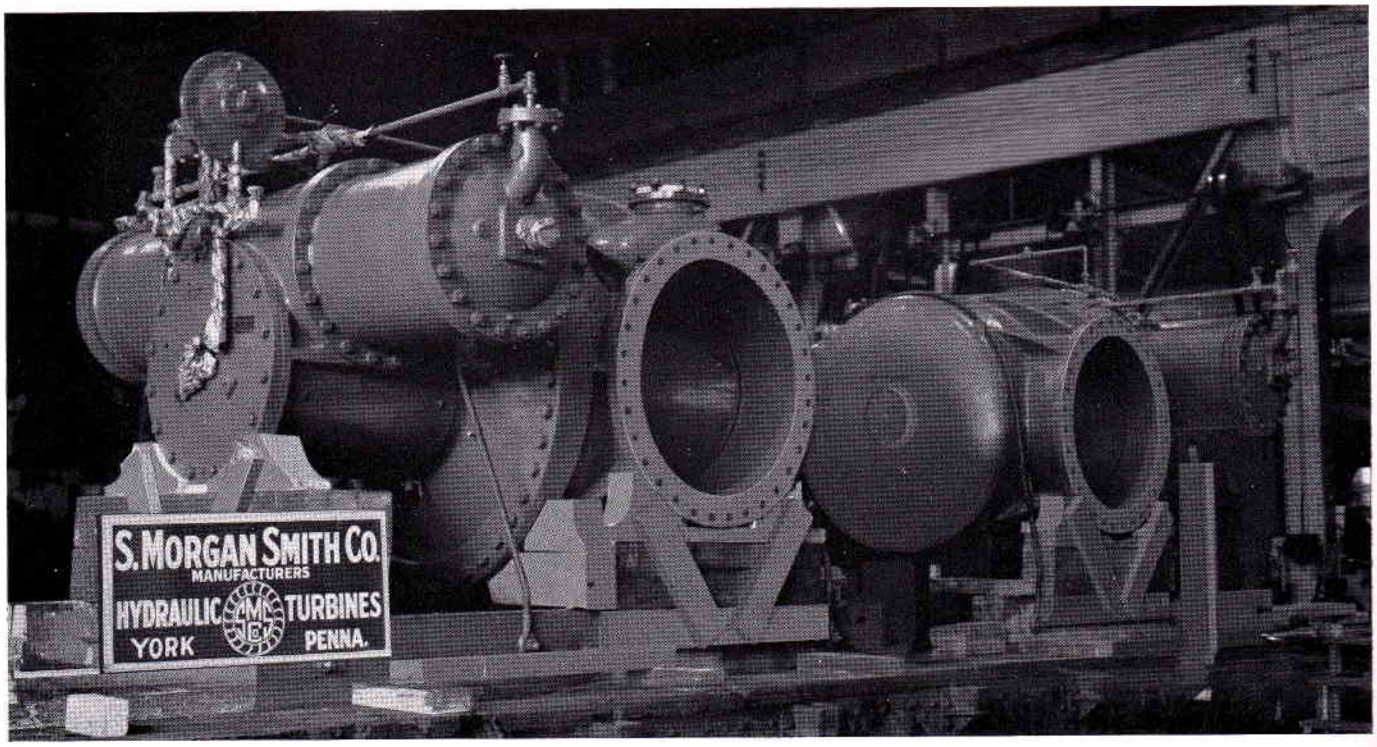
Valves for these services are basically standard hydraulic ROTOVALVES equipped with the proper controls.

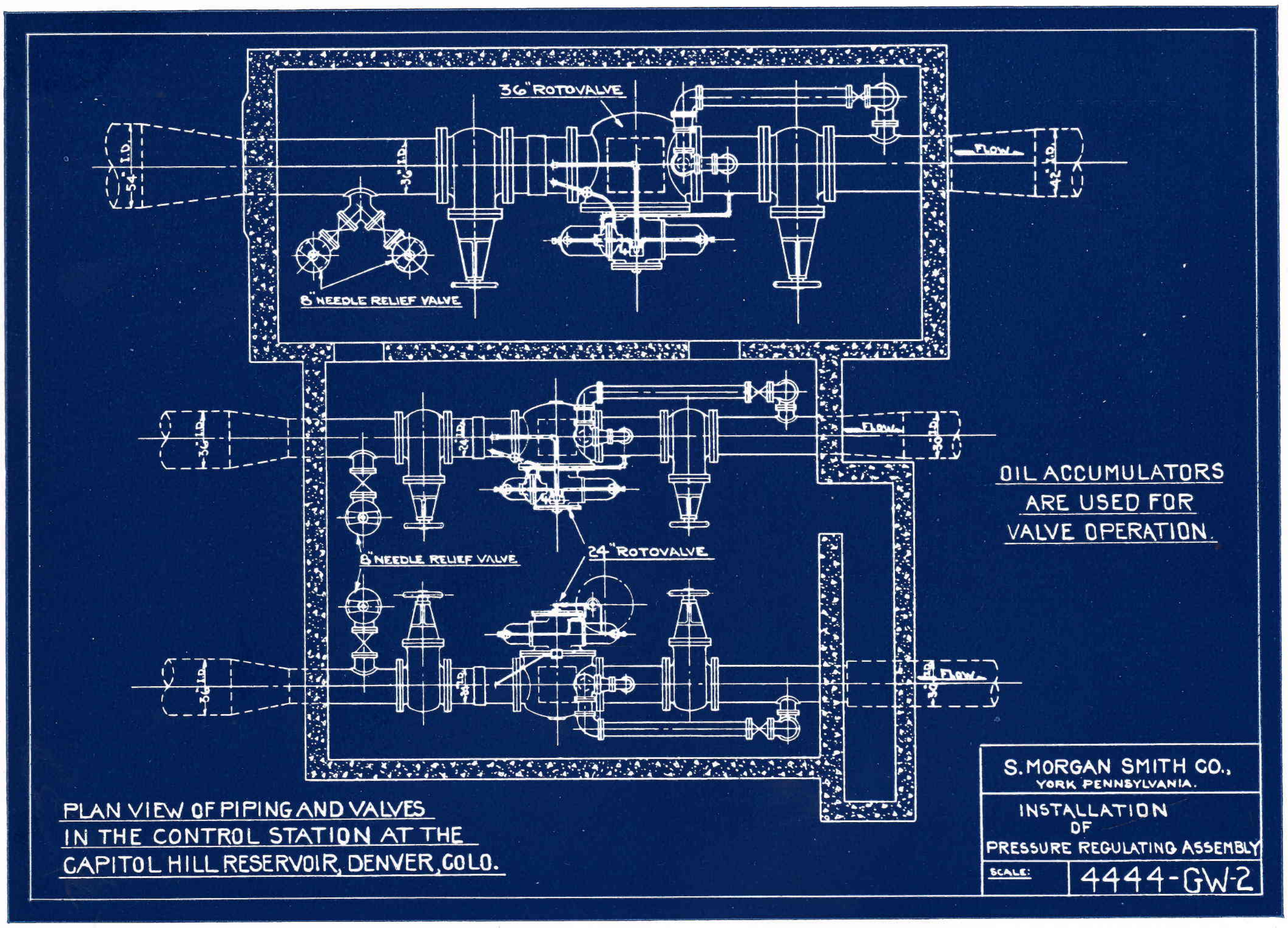
Sectional assembly drawings showing parts and materials will be found on pages 8 and 9. A drawing illustrating typical arrangements is shown on page 10. The outline dimension drawings, pages 16 to 19 inclusive, also apply to this type of valve.

These valves are normally operated in some *throttled* position and generally are constantly in motion.

Experience gained over the past fifteen years has disclosed that all types of valves when operated under high pressure differentials are subjected to severe abuse. It has been noted that high velocities due to these differentials have caused considerable vibration in many designs of valves. In addition, serious cavitating effects have also been noted where certain designs have not been properly vented. We recommend that valve bodies for *throttling services* be provided with cast manifolds on their downstream sections. These manifolds are for connection to the low pressure side for recirculation of low pressure water into and through the vacuum areas. This system is commonly known as the recirculating system of vacuum relief, and is covered by patent. The drawings showing a section through the valve body and manifold, and the general piping arrangement and a description will be found on page 34.

Two of a number of large automatic pressure reducing valves in shipment to the City of Denver, Colorado.





Pressure *Reducing* SERVICE

VALVES for pressure reducing service function to maintain a constant pressure on their discharge side regardless of any variation in pressure on the inlet side.

There are many varied applications of this type of valve such as the reduction of pressure at any predetermined point in a distribution system or flow line; the interlocking of high and low services for balancing peak loads; inlet controls to reservoirs or mixing basins; and any type of installation where it is desired to create loss in head or control pressure. Low pressures can normally be maintained within a variation of two pounds plus or minus, where the differential does not exceed 60 pounds. As pressure differentials increase, there is a natural tendency toward slightly higher variations in pressure control limits. Installations have been made where the pressure differentials were as high as 250 pounds across a single valve. Better control and lower variation will be obtained if the differential is limited to a maximum of 100 pounds per valve. This practice will increase the longevity of the equipment.

It has been found far more practical to use a series of valves in a long line each proportionately reducing the pressure rather than to use one unit with a high differential at the lower extremity of the line. This arrangement permits greater line flexibility and control of surges.

Pressure Relief Service

A PRESSURE relief valve is one which functions to limit to a predetermined maximum the pressure on its inlet side regardless of any variation in the pressure on its outlet side.

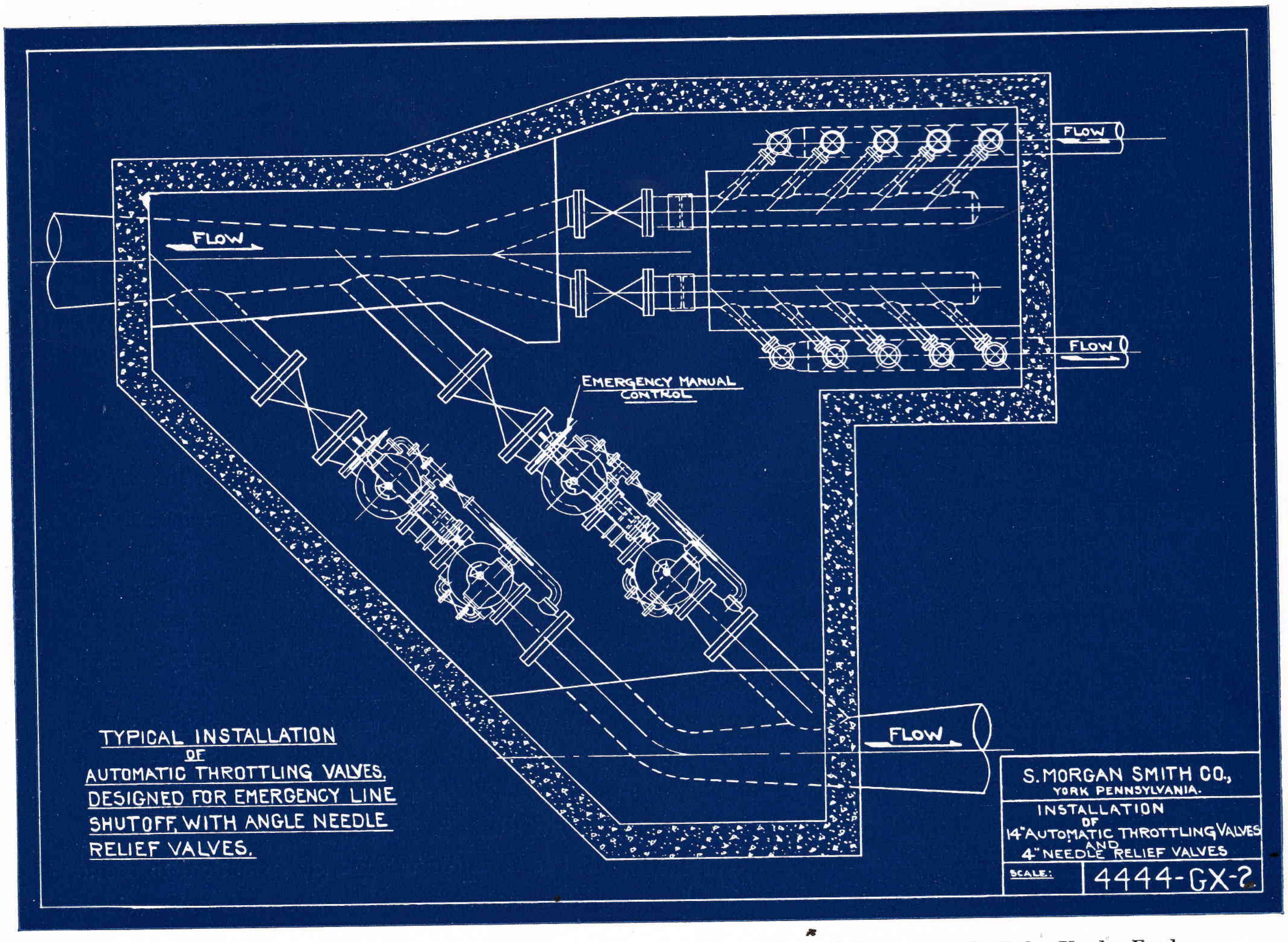
One example of pressure relief service would be the installation of a valve in a gravity line for the maintenance of a predetermined low pressure in the system above the valve.

Valves for pressure relief and pressure reducing services may be equipped with auxiliary manual mechanical means of operation as described on page 25.

Flow Control SERVICE

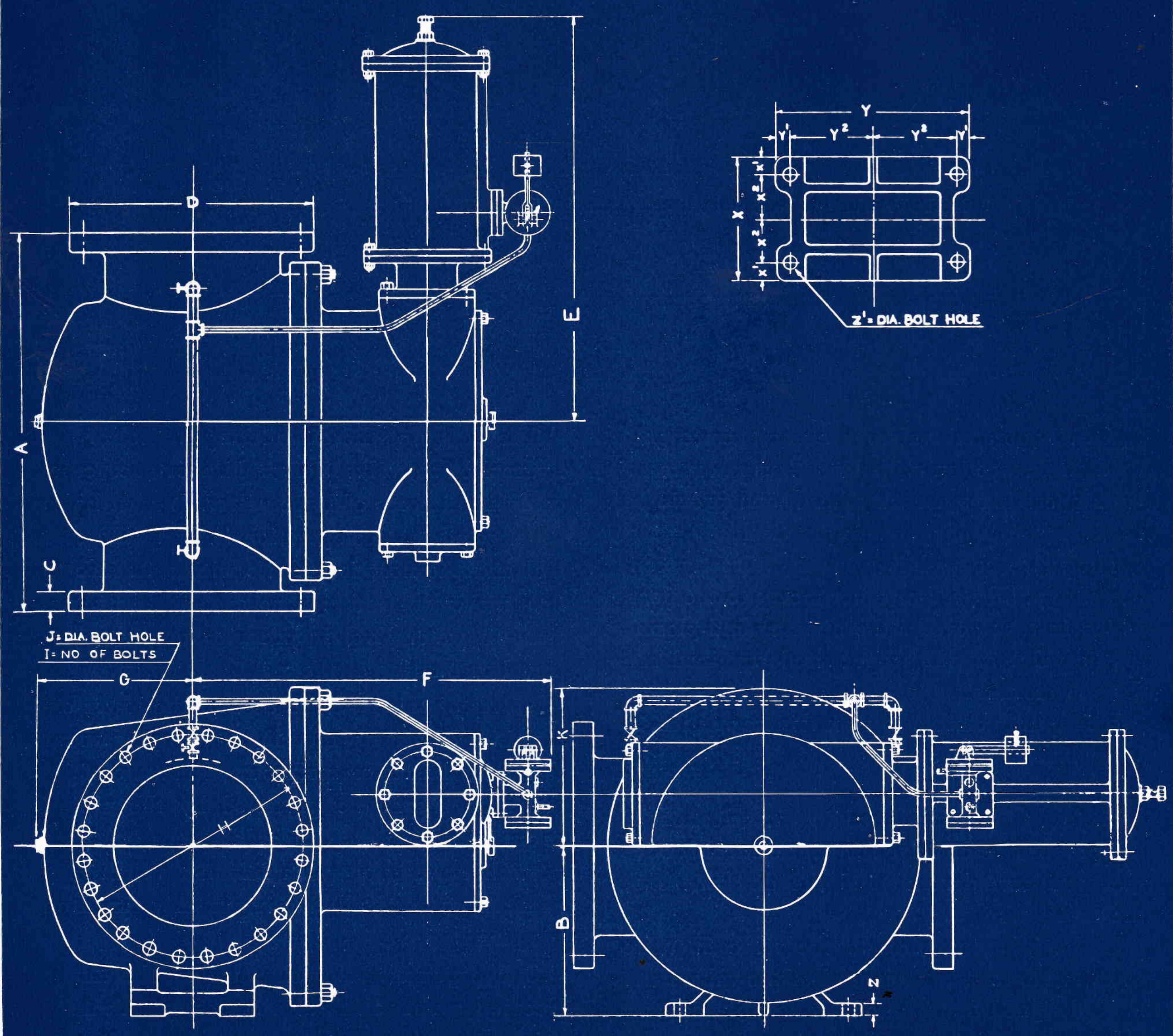
A FLOW control valve is one which maintains a predetermined rate of flow through the valve irrespective of pressure variations on its inlet or outlet sides.

ROTOVALVES adapted to this service may be advantageously used to maintain a constant rate of flow into a feeder line from some particular source of water supply or in other similar situations where constant volume is desired.

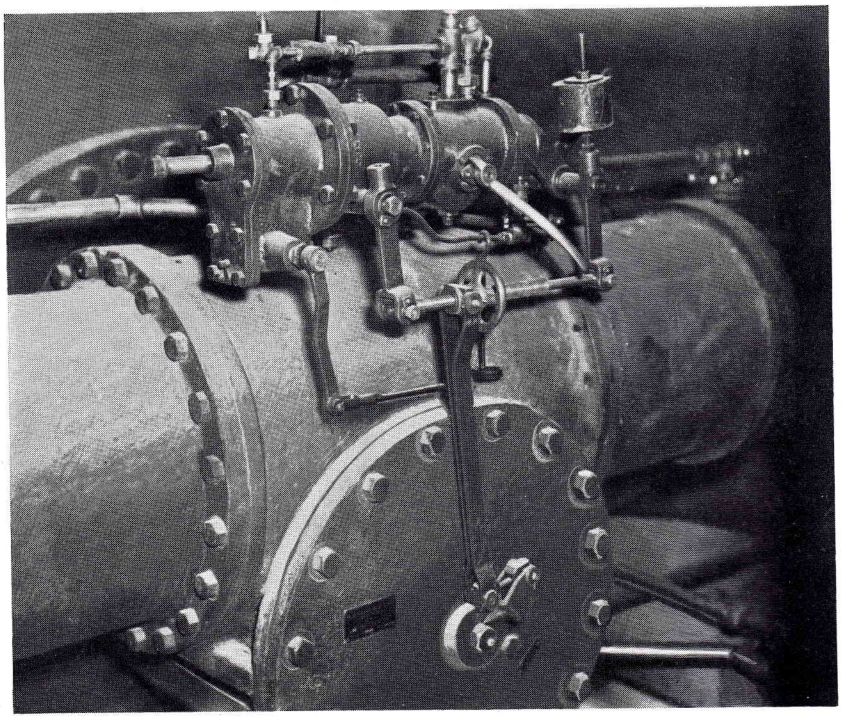


Plan view of the automatic throttling valves and battery of angle needle relief valves on the Palos Verdes Feeder Line of the Metropolitan Water District of Southern California. These ROTOVALVES are designed to maintain a predetermined minimum pressure on their upstream sides and also to close in the event that the pressure on their downstream sides drops below a predetermined point. They are also provided with auxiliary manual mechanical means of operation.

Valve Size	STANDARD 125 LBS. OPERATING PRESSURE																			250 LBS. OPERATING PRESSURE					
	A	B	C	D	E	F	G	H	I	J	K	X	X^1	X^2	Y	Y^1	Y^2	Z	Z^1	A	C	D	H	I	J
6"	23 1/8"	9 1/2"	1"	11"	33 1/2"	23 3/4"	7 1/2"	9 1/2"	8	7/8"	17 7/8"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	24"	1 7/16"	12 1/2"	10 5/8"	12	7/8"
8"	23 1/2"	9 1/2"	1 1/8"	13 1/2"	33 1/2"	23 3/4"	8 3/4"	11 3/4"	8	7/8"	17 7/8"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	24 1/2"	1 5/8"	15"	13"	12	1"
10"	28 1/8"	12"	1 3/16"	16"	33 1/2"	25 1/4"	11 1/2"	14 1/4"	12	1"	17 7/8"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	29 1/2"	1 7/8"	17 1/2"	15 1/4"	16	1 1/8"
12"	31"	14"	1 1/4"	19"	39 7/8"	28 3/4"	12 1/2"	17"	12	1"	20 3/8"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	32 1/2"	2"	20 1/2"	17 3/4"	16	1 1/4"
14"	35 1/2"	15 1/2"	1 3/8"	21"	39 7/8"	29 3/4"	13 1/4"	18 3/4"	12	1 1/8"	20 3/8"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	37"	2 1/8"	23"	20 1/4"	20	1 1/4"
16"	39"	17 1/8"	1 7/16"	23 1/2"	46 1/2"	33 3/4"	15 1/2"	21 1/4"	16	1 1/8"	23 1/8"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	41"	2 1/4"	25 1/2"	22 1/2"	20	1 3/8"
18"	41 3/4"	19 1/4"	1 9/16"	25"	46 1/2"	34 3/4"	17 3/4"	22 3/4"	16	1 1/4"	23 1/8"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	43 3/8"	2 3/8"	28"	24 3/4"	24	1 3/8"
20"	47"	22"	1 11/16"	27 1/2"	56 1/4"	40"	19 1/2"	25"	20	1 1/4"	30 3/4"	20"	2"	8"	31 1/2"	1 3/4"	14"	1 3/4"	1 3/4"	48 5/8"	2 1/2"	30 1/2"	27"	24	1 3/8"
24"	56"	26"	1 7/8"	32"	56 1/4"	43 3/4"	21 1/4"	29 1/2"	20	1 3/8"	30 3/4"	20"	2"	8"	31 1/2"	1 3/4"	14"	1 3/4"	1 3/4"	57 3/4"	2 3/4"	36"	32"	24	1 5/8"
30"	64"	30 1/2"	2 1/8"	38 3/4"	87"	57 3/4"	27"	36"	28	1 3/8"	39 1/8"	30"	5"	10"	30"	2 1/2"	12 1/2"	1 1/2	2 1/4"	65 3/4"	3"	43"	39 1/4"	28	1 7/8"
36"	70 1/2"	35"	2 3/8"	46"	87"	61"	28 1/2"	42 3/4"	32	1 5/8"	39 1/8"	35 1/2"	4 1/4"	13 1/2"	36"	3"	15"	1 1/2"	2 1/4"	74"	3 3/8"	50"	46"	32	2 1/4"
42"	83 1/4"	43"	2 5/8"	53"	110 1/4"	75"	36"	49 1/2"	36	1 5/8"	43 5/8"	42"	5 1/2"	15 1/2"	42"	4"	17"	2 1/4"	2 5/8"	85 3/8"	3 11/16"	57"	52 3/4"	36	2 1/4"
48"	93"	47 1/2"	2 3/4"	59 1/2"	110 1/4"	78 1/2"	40 1/2"	56"	44	1 5/8"	43 5/8"	54"	6"	21"	54"	6"	21"	2 1/2"	2 5/8"	95 1/2"	4"	65"	60 3/4"	40	2 1/4"
54"	101"	54"	3"	66 1/4"	110 1/4"	81 1/2"	47 1/2"	62 3/4"	44	1 7/8"	48 5/8"	54"	6"	21"	54"	6"	21"	2 3/4"	2 3/4"			SPECIAL			
60"	111"	61"	3 1/8"	73"	110 1/4"	84 1/2"	51 1/2"	69 1/4"	52	1 7/8"	48 5/8"	60"	9"	21"	60"	9"	21"	2 3/4"	3"			SPECIAL			



OUTLINE DIMENSION DRAWING OF STANDARD HYDRAULIC ROTOVALVE WITH PRESSURE REDUCING CONTROL AND CYLINDER HORIZONTAL.



36″ ROTOVALVE with float operated control, Moffat Filter Plant, Denver, Colorado.

FLOAT *CONTROL* SERVICE

FLOAT operated valves are most commonly used in connection with large basins or reservoirs operating under any head, and providing the installation of a float is practical.

The valve control is generally directly connected by cable, rod or other means to the float, which in turn governs the opening and closing of the valve at the proper predetermined settings of elevation.

It is quite possible to maintain regulation of large basins over a range limit of 1½ inches plus or minus.

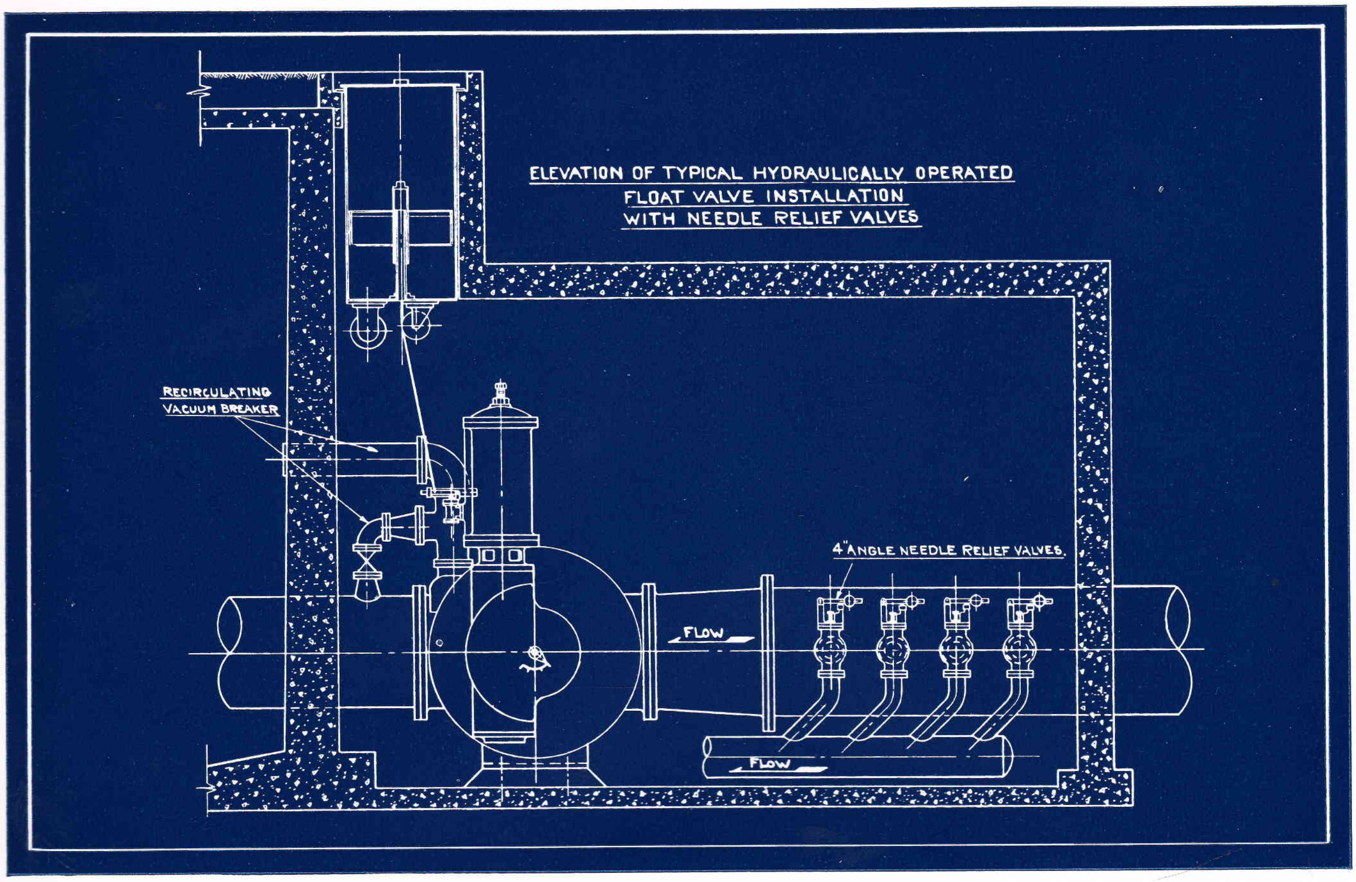
Factors to be considered in the selection of the proper size of valve for float control service are maximum demand and the dimensions of the basin.

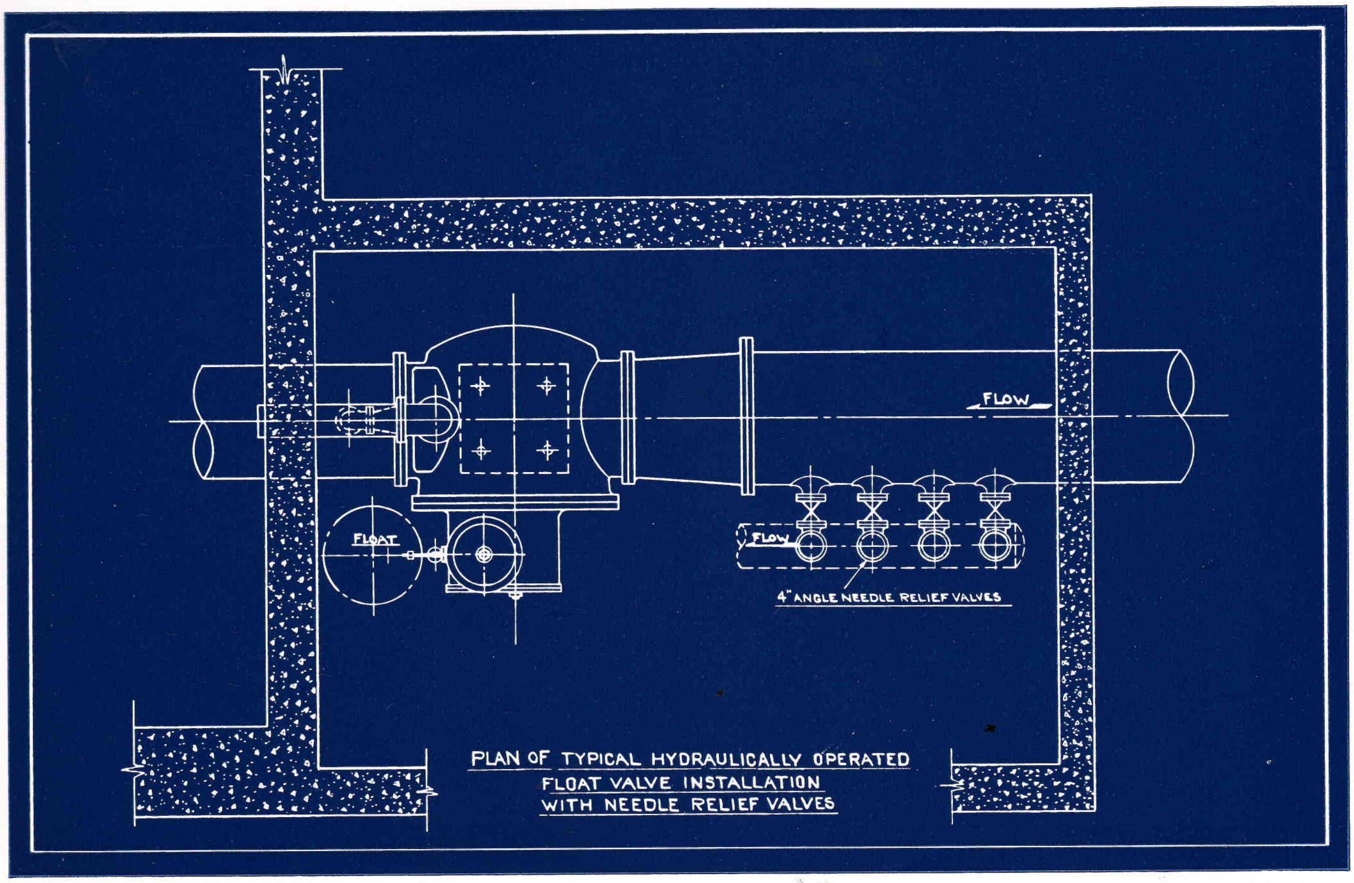
If the inlet pressures to the valve fluctuate over a wide range, the control of the valve must be so designed that it also may be adjusted over a wide range of timing. This adjustment may be independent for the opening and closing cycles.

The design of the distributing control of the hydraulic float valve is of vital importance, especially in the case of large valves. It must be so constructed that co-operation between the control and the float is definite with reference to float movement and responsive to slight fluctuations in water level in order to prevent overtravel or hunting of the main valve plug.

Valves of this type are used at the lower extremities of gravity flow lines supplying water to mixing basins or reservoirs. This type of installation should be protected by the use of pressure relief valves in order to prevent any possible surging or water hammer which may result from a valve being improperly timed on the closing cycle.

Our experience has shown that the Angle Needle type of relief valve is most practical for this service. A typical arrangement appears on the facing page.


ELEVATION OF TYPICAL HYDRAULICALLY OPERATED
FLOAT VALVE INSTALLATION
WITH NEEDLE RELIEF VALVES
RECIRCULATING
VACUUM BREAKER
4" ANGLE NEEDLE RELIEF VALVES.
FLOW
FLOW


FLOW
FLOAT
FLOW
4" ANGLE NEEDLE RELIEF VALVES
PLAN OF TYPICAL HYDRAULICALLY OPERATED
FLOAT VALVE INSTALLATION
WITH NEEDLE RELIEF VALVES

MANIFOLDS

MANIFOLDS for distributing water to vacuum areas by means of a recirculating system are designed to properly supply water in sufficient quantities to those sections where cavitation is most likely to occur.

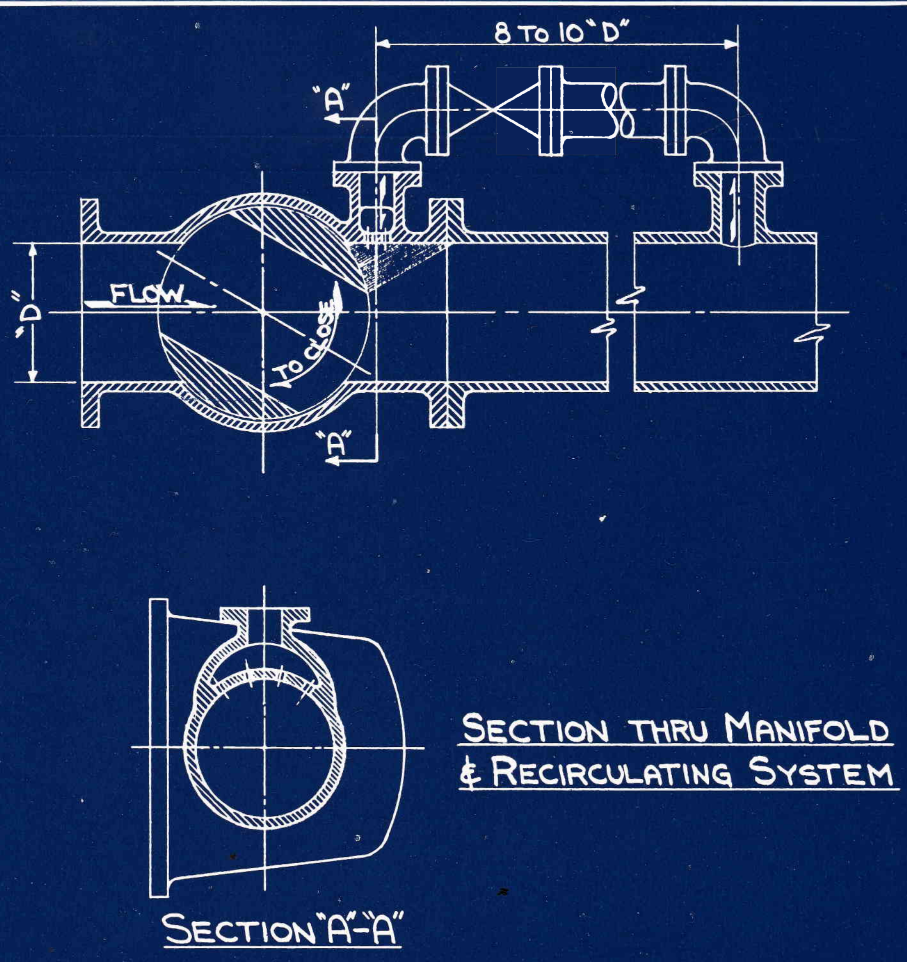
They are cast integrally with the body and provided with a flanged connection to which is attached the piping for returning water from the low pressure side.

The return pipe should be connected at least 10 ft. downstream and equipped with a gate valve to throttle the return supply. Vacuum areas increase or decrease with increments of velocity when the plug changes position to compensate for fluctuations in demand or upstream pressures.

The table below shows the correct size of manifold pipes for various sizes of valves. The necessary pipes and fittings are not included in the valve price but can be furnished at an additional charge. The cost of connecting this auxiliary piping is always borne by the customer.

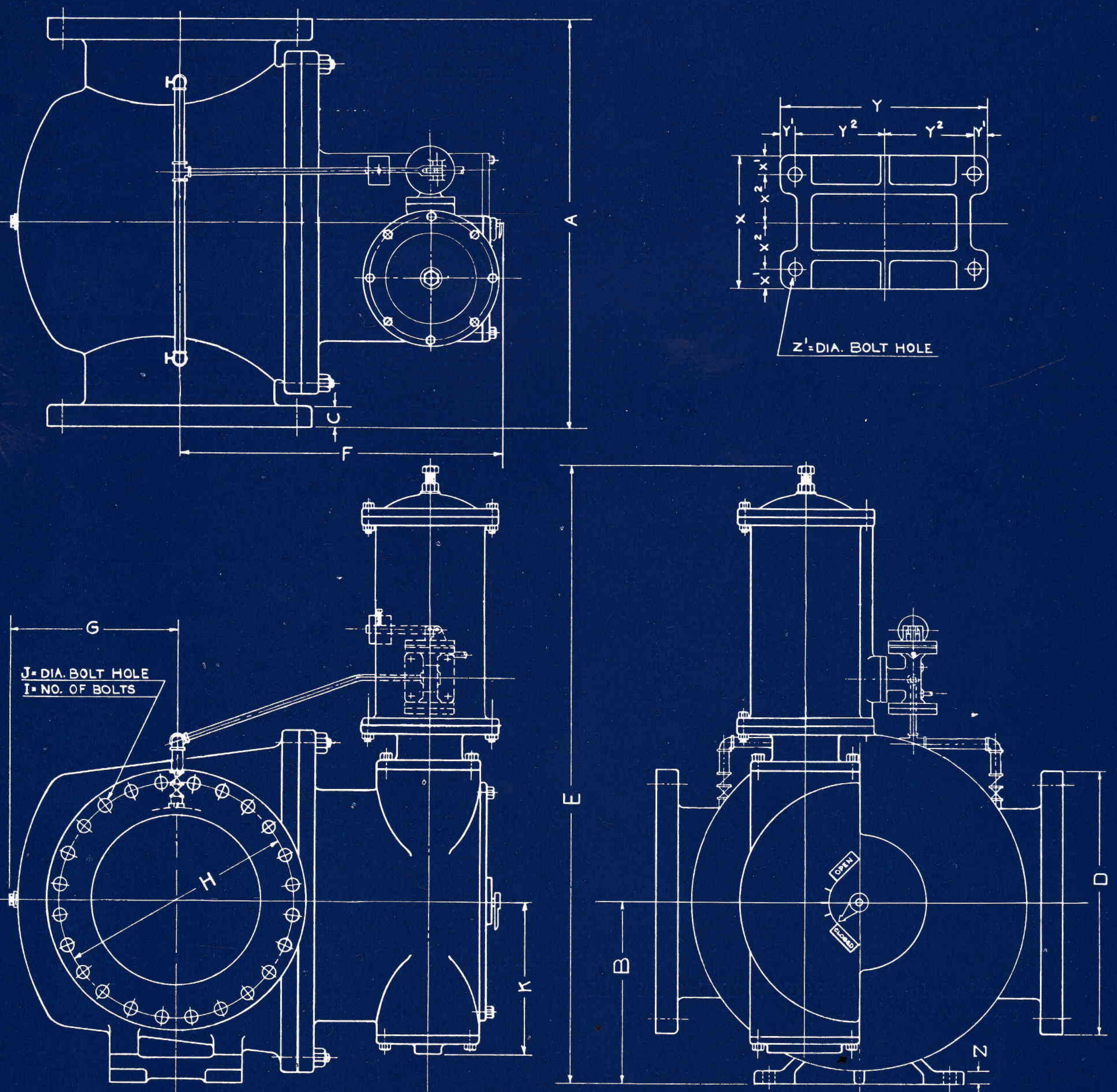
In the case of free discharge valves, it is recommended that provision be made to adequately vent the cavitation areas.

Valve Size	Manifold Pipe Size
6"	2"
8"	2"
10"	2"
12"	3"
14"	3"
16"	3"
18"	4"
20"	4"
24"	4"
30"	6"
36"	6"
42"	8"
48"	8"
54"	10"
60"	10"



Section thru Manifold & Recirculating System

	Standard 125 lbs. Operating Pressure																			250 lbs. Operating Pressure					
Valve Size	A	B	C	D	E	F	G	H	I	J	K	X	X^1	X^2	Y	Y^1	Y^2	Z	Z^1	A	C	D	H	I	J
6"	23 1/8"	9 1/2"	1"	11"	43"	23 3/4"	7 1/2"	9 1/2"	8	7/8"	11 3/8"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	24"	1 7/16"	12 1/2"	10 5/8"	12	7/8"
8"	23 1/2"	9 1/2"	1 1/8"	13 1/2"	43"	23 3/4"	8 3/4"	11 3/4"	8	7/8"	11 3/8"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	24 1/2"	1 5/8"	15"	13"	12	1"
10"	28 1/8"	12"	1 3/16"	16"	45 1/2"	25 1/4"	11 1/2"	14 1/4"	12	1"	11 3/8"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	29 1/2"	1 7/8"	17 1/2"	15 1/4"	16	1 1/8"
12"	31"	14"	1 1/4"	19"	53 7/8"	28 3/4"	12 1/2"	17"	12	1"	12 7/8"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	32 1/2"	2"	20 1/2"	17 3/4"	16	1 1/4"
14"	35 1/2"	15 1/2"	1 3/8"	21"	55 3/8"	29 3/4"	13 1/4"	18 3/4"	12	1 1/8"	12 7/8"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	37"	2 1/8"	23"	20 1/4"	20	1 1/4"
16"	39"	17 1/8"	1 7/16"	23 1/2"	63 5/8"	33 3/4"	15 1/2"	21 1/4"	16	1 1/8"	15 7/8"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	41"	2 1/4"	25 1/2"	22 1/2"	20	1 3/8"
18"	41 3/4"	19 1/4"	1 9/16"	25"	65 3/4"	34 3/4"	17 3/4"	22 3/4"	16	1 1/4"	15 7/8"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	43 3/8"	2 3/8"	28"	24 3/4"	24	1 3/8"
20"	47"	22"	1 11/16"	27 1/2"	78 1/4"	40"	19 1/2"	25"	20	1 1/4"	20 1/2"	20"	2"	8"	31 1/2"	1 3/4"	14"	1 3/4"	1 3/4"	48 5/8"	2 1/2"	30 1/2"	27"	24	1 3/8"
24"	56"	26"	1 7/8"	32"	82 1/4"	43 3/4"	21 1/4"	29 1/2"	20	1 3/8"	20 1/2"	20"	2"	8"	31 1/2"	1 3/4"	14"	1 3/4"	1 3/4"	57 3/4"	2 3/4"	36"	32"	24	1 5/8"
30"	64"	30 1/2"	2 1/8"	38 3/4"	117 1/2"	57 3/4"	27"	36"	28	1 3/8"	31"	30"	5"	10"	30"	2 1/2"	12 1/2"	1 1/2	2 1/4"	65 3/4"	3"	43"	39 1/4"	28	1 7/8"
36"	70 1/2"	35"	2 3/8"	46"	122"	61"	28 1/2"	42 3/4"	32	1 5/8"	31"	35 1/2"	4 1/4"	13 1/2"	36"	3"	15"	1 1/2"	2 1/4"	74"	3 3/8"	50"	46"	32	2 1/4"
42"	83 1/4"	43"	2 5/8"	53"	153 1/4"	75"	36"	49 1/2"	36	1 5/8"	37 3/4"	42"	5 1/2"	15 1/2"	42"	4"	17"	2 1/4"	2 5/8"	85 3/8"	3 11/16"	57"	52 3/4"	36	2 1/4"
48"	93"	47 1/2"	2 3/4"	59 1/2"	157 3/4"	78 1/2"	40 1/2"	56"	44	1 5/8"	37 3/4"	54"	6"	21"	54"	6"	21"	2 1/2"	2 5/8"	95 1/2"	4"	65"	60 3/4"	40	2 1/4"
54"	101"	54"	3"	66 1/4"	164 1/4"	81 1/2"	47 1/2"	62 3/4"	44	1 7/8"	50"	54"	6"	21"	54"	6"	21"	2 3/4"	2 3/4"			SPECIAL			
60"	111"	61"	3 1/8"	73"	171 1/4"	84 1/2"	51 1/2"	69 1/4"	52	1 7/8"	50"	60"	9"	21"	60"	9"	21"	2 3/4"	3"			SPECIAL			



OUTLINE DRAWING OF STANDARD HYDRAULIC VALVE
WITH PRESSURE REDUCING CONTROL AND CYLINDER VERTICAL.

Pressure Reducing CONTROL

A cross section of a pressure reducing control is shown on page 37. The control consists of a small four-way valve and a counterbalanced diaphragm. Pressure water moving the diaphragm actuates the four-way valve. Regulation of the line pressure is accomplished through the operation of the counterweight.

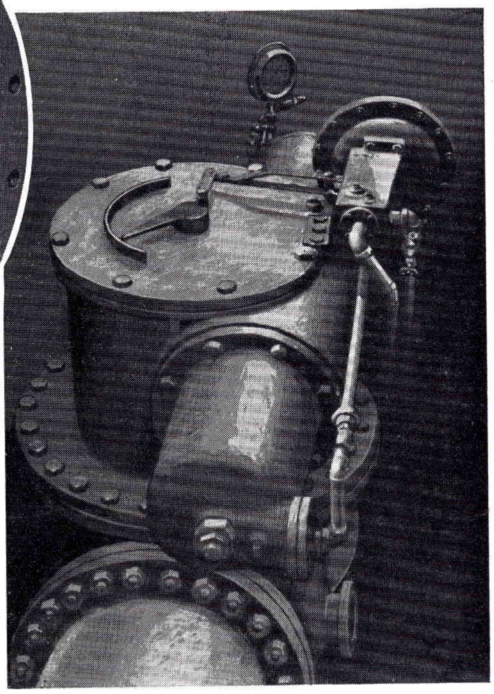
It will be noted that in order to reduce friction, no packing glands are used in this design. The weight is located on a lever which in turn is mounted on needle roller bearings. Limits of travel are established by the housing and cover in such a manner that no heavy loads are imposed upon the small light working parts.

The construction is simple. The water pressure is admitted to the diaphragm and depending upon its variation, the diaphragm moves to operate the pilot stem, thus causing the desired response in the ROTOVALVE.

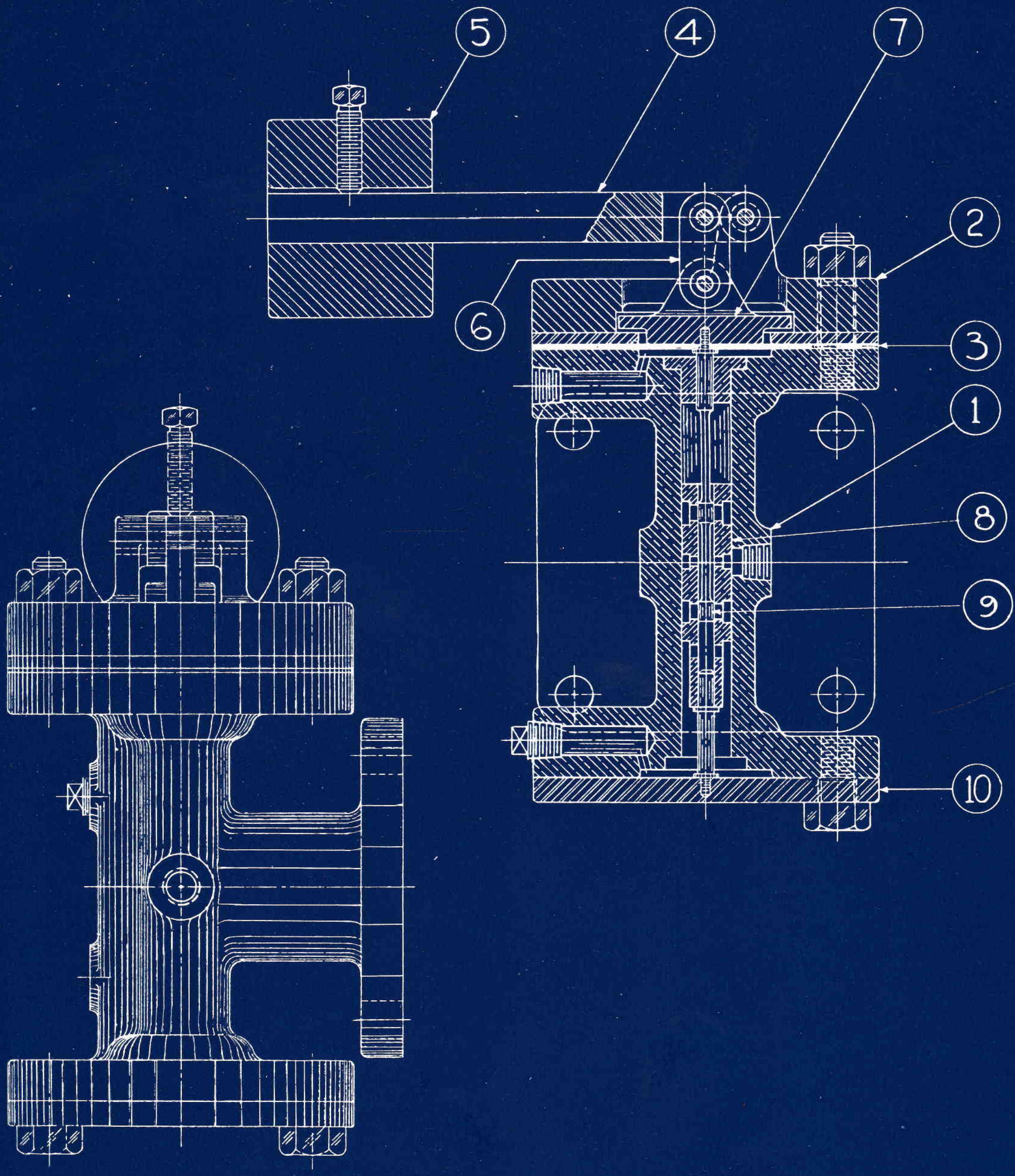
Standard hydraulic ROTOVALVE fitted with pressure reducing control.

Pressure Relief CONTROL

THE pressure reducing control is also used for pressure *relief* service by a suitable change in connections. The ROTOVALVE is thus made to regulate the *inlet* pressure.



20″ pressure reducing valve installed in high pressure line, City of Los Angeles, California.



No.	Name of Part	Material	Specification
1	Housing	Bronze	ASTM B60-36
2	Operating End	Cast Iron	ASTM A48-36 No. 40
3	Diaphragm	Rubber	
4	Operating Lever	Steel	
5	Counter Weight	Lead	
6	Link	Brass	
7	Diaphragm Plate	Cast Iron	ASTM A48-36 No. 40
8	Sleeve	Bronze	ASTM B74-32T
9	Plunger	Monel	Comm.
10	Bottom Plate	Steel	Comm.

SECTIONAL DRAWING OF STANDARD PRESSURE REDUCING CONTROL.

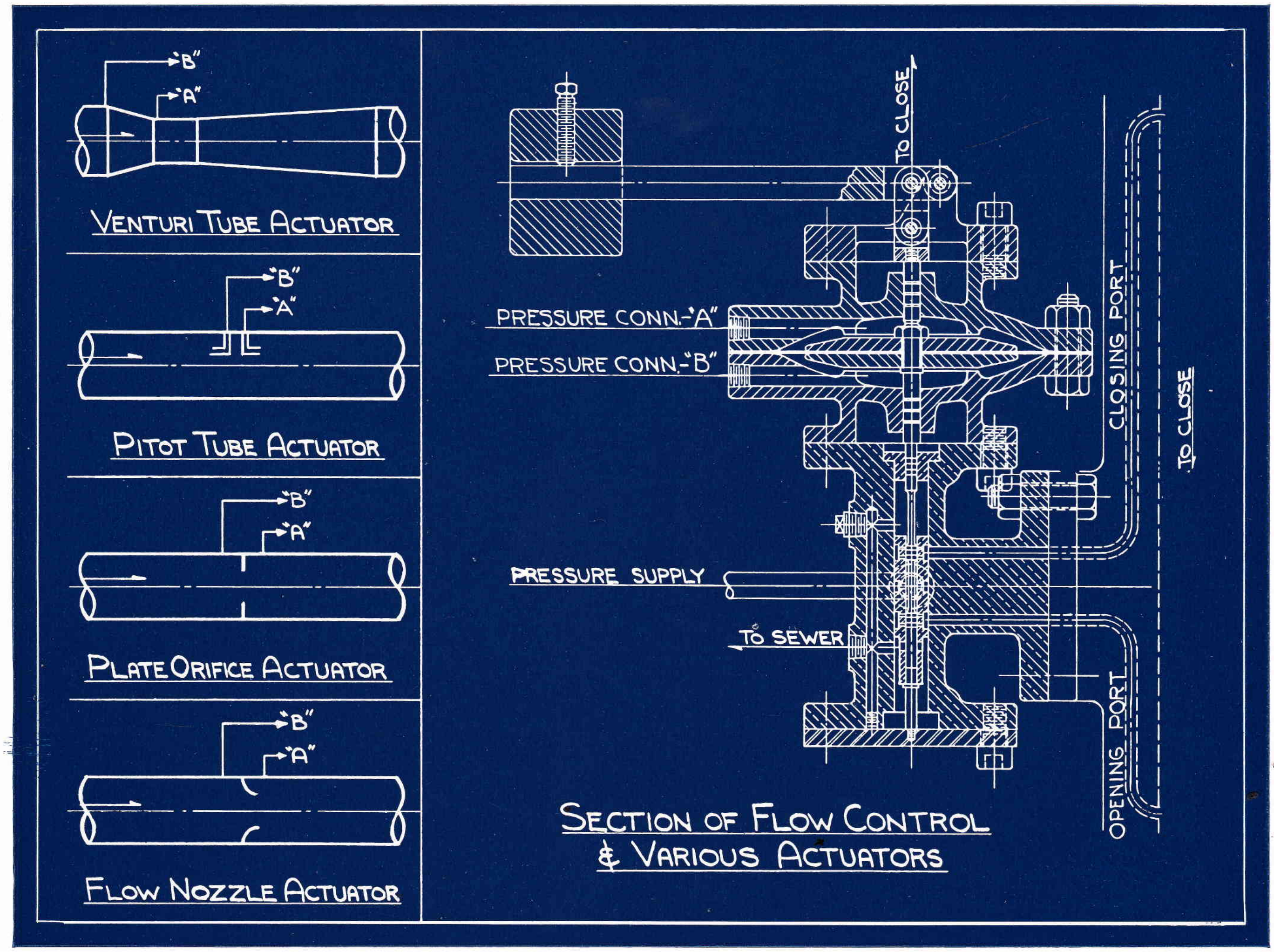
Flow CONTROL

A SECTIONAL assembly of the flow control and various methods of actuating it are shown on the drawing below. The control consists of a four-way valve operated by a weight-loaded differential diaphragm. By adjusting the position of the weight, the differential pressure and hence the flow required to maintain a neutral position of the control is established. If the flow changes, so causing a change in differential pressure, the diaphragm becomes unbalanced moving the four-way valve in a direction causing operation of the ROTOVALVE to bring the flow back to normal.

Of the several actuators shown below the venturi tube, the plate orifice, and the flow nozzle are connected to piezometers. However, in the case of a straight pipe, pitot tubes facing upstream and downstream must be used.

Float CONTROL

THE control mechanism, as shown on page 37, may also be used for float service. In this case, the diaphragm pressure and weight are not used, but a float actuates the lever arm, which operates the pilot stem, thus causing the desired response in the ROTOVALVE.



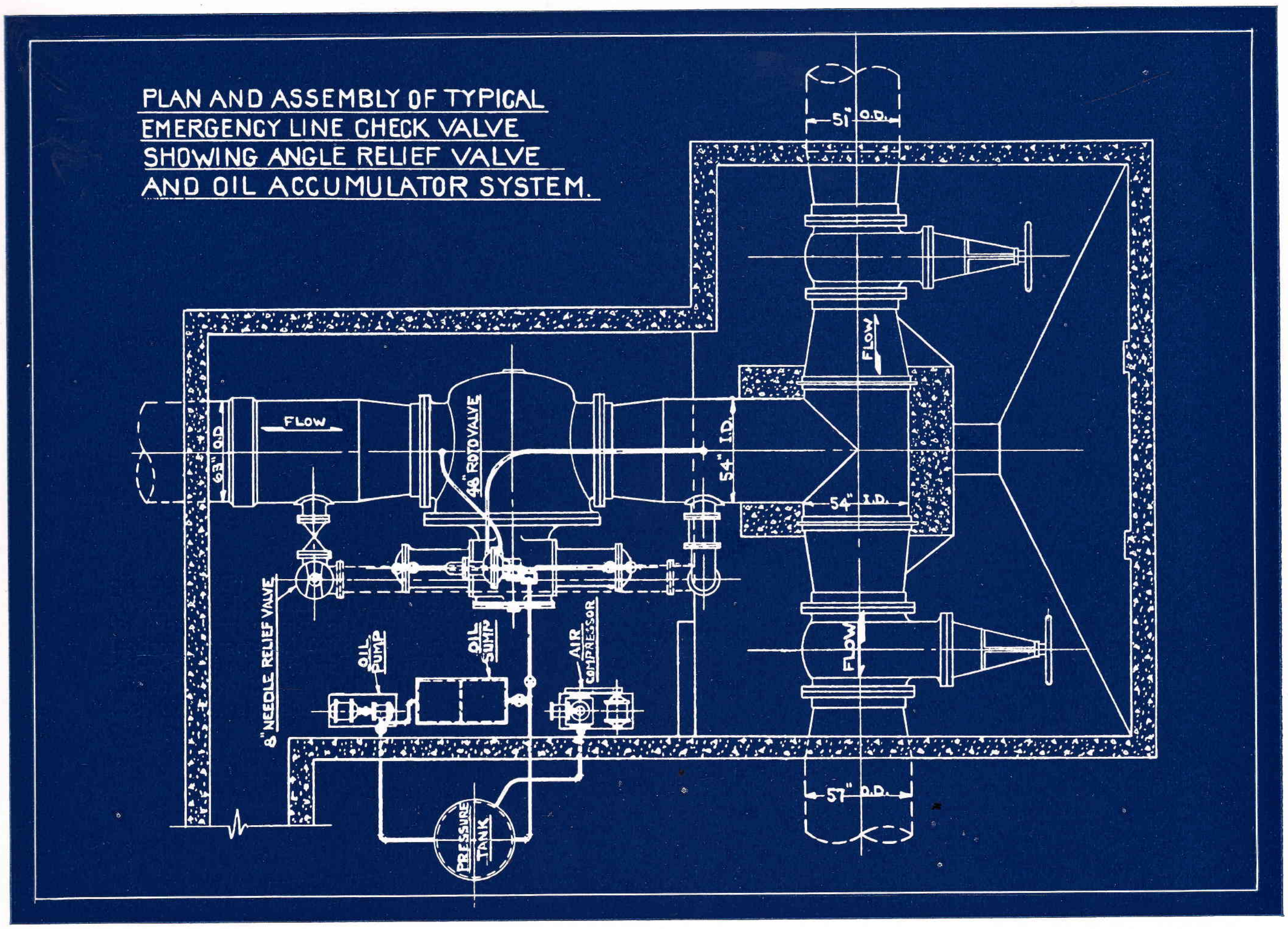
ACCUMULATORS

IN GENERAL, power water for operation of a hydraulic valve is secured from the pipe line which the valve controls. Under certain circumstances pipe line pressure may be too low or it may be converted completely to velocity thus making it impossible to operate the valve. In such cases it becomes necessary to install an accumulator system.

An accumulator system in general consists of a tank containing water or oil under air pressure. In certain situations it may be possible to charge the tank from the pipe line but in general a power pump is used to force the operating fluid, preferably oil, into the pressure tank.

The drawing below shows the installation of an oil accumulator system installed where the pipe line pressure was too low to assure proper operation.

The check valves for the Metropolitan Water District of Southern California use oil accumulator systems operating at 300 lbs. per square inch working pressure.



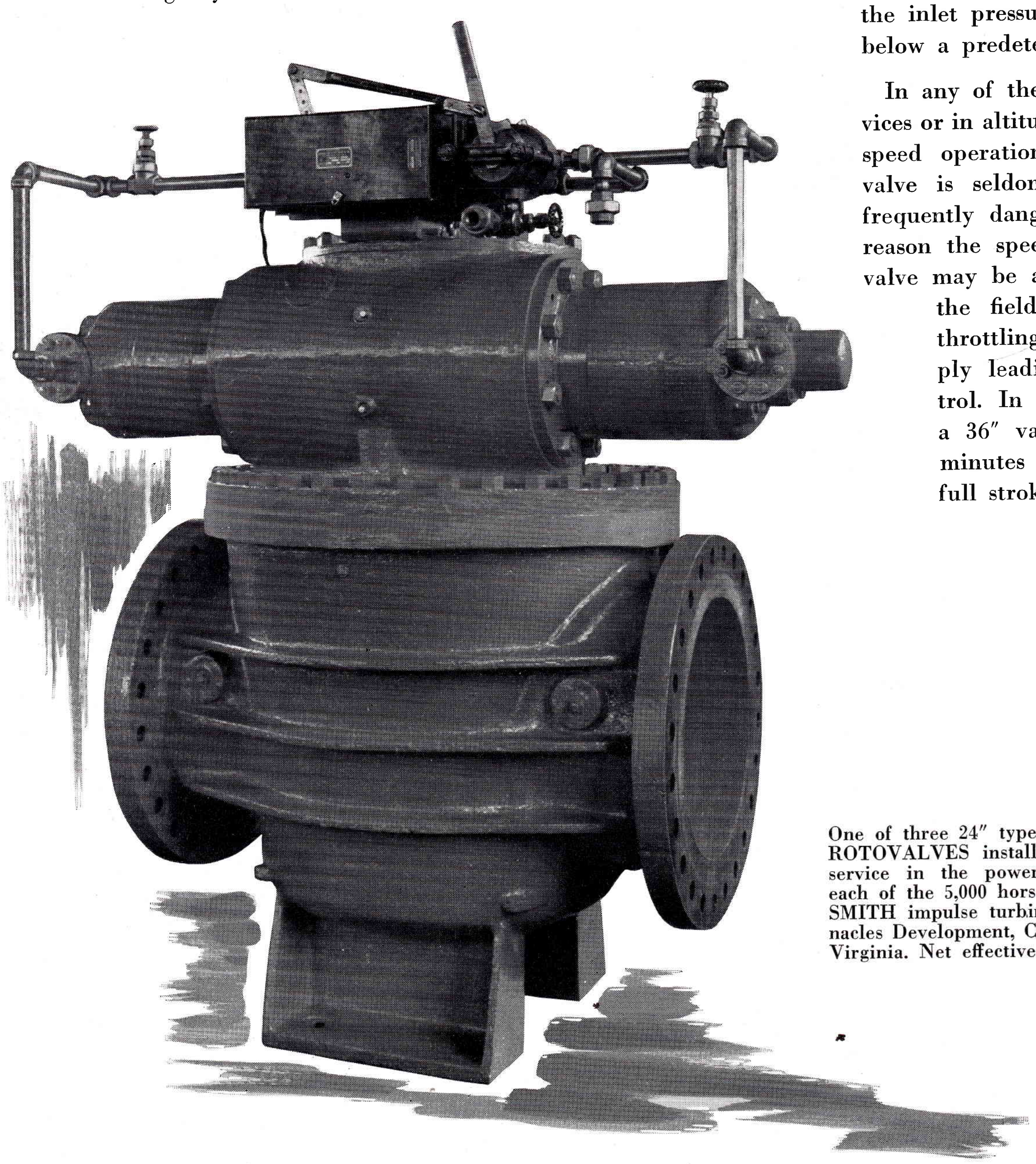
Dual Control

THE drawing on page 41 illustrates the construction of a dual control valve. This control is almost identical to the pressure reducing or pressure relief control with the addition of a second diaphragm which operates the internal sleeve instead of the pilot stem.

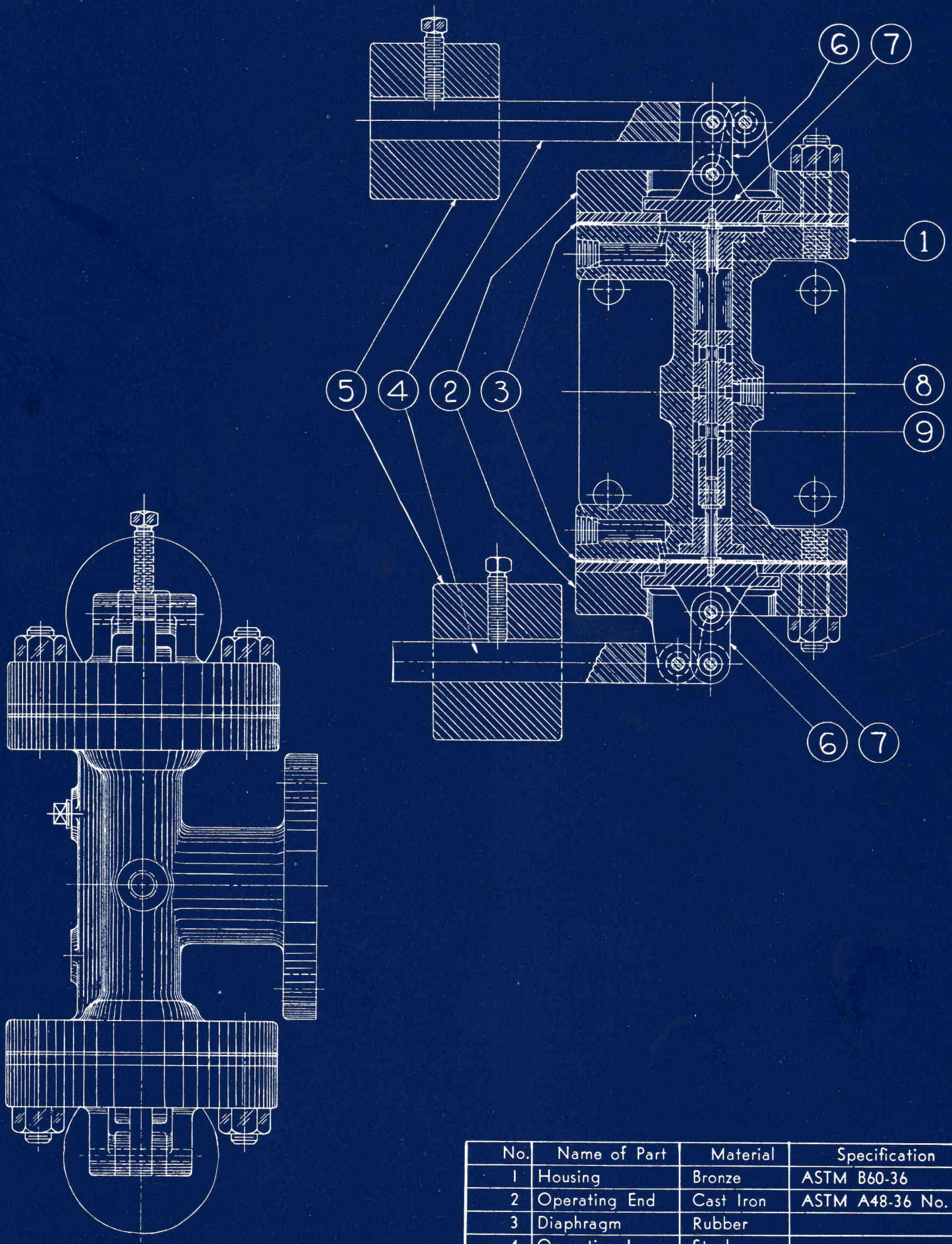
There are many applications for the use of the dual control, the most common being for emergency shut-off service furnished with or without mechanical lockout. It may thus be used in combination with a pressure reducing or pressure relief valve. Its function is to close the valve on high or low pressure according to the requirements of the installation. It may also be used in conjunction with several of the altitude type controls. One diaphragm responds to one set of conditions and the other diaphragm responds to another.

For example, it may be so connected that the main ROTOVALVE will function to act as a pressure reducing valve to maintain a predetermined discharge pressure, but also to prevent the inlet pressure from falling below a predetermined setting.

In any of the throttling services or in altitude service, high speed operation of the main valve is seldom used and is frequently dangerous. For this reason the speed of the main valve may be adjusted to suit the field conditions by throttling the power supply leading to the control. In one installation a 36″ valve requires 57 minutes to complete a full stroke.



One of three 24″ type "B" hydraulic ROTOVALVES installed for shut-off service in the power penstocks of each of the 5,000 horsepower vertical SMITH impulse turbines at the Pinnacles Development, City of Danville, Virginia. Net effective head 660 feet.



No.	Name of Part	Material	Specification
1	Housing	Bronze	ASTM B60-36
2	Operating End	Cast Iron	ASTM A48-36 No. 40
3	Diaphragm	Rubber	
4	Operating Lever	Steel	
5	Counter Weight	Lead	
6	Link	Brass	
7	Diaphragm Plate	Cast Iron	ASTM A48-36 No. 40
8	Sleeve	Bronze	ASTM B74-32T
9	Plunger	Monel	Comm.

SECTIONAL ASSEMBLY OF DUAL CONTROL.

ALTITUDE VALVES AND CONTROLS

THE standard altitude valve is identical in all respects to the standard hydraulic ROTO-VALVE with the proper controls added. The hydraulic cylinders and general arrangement of piping insofar as the assemblies are concerned can be made in accordance with the chart showing the various assemblies of hydraulic valves as referred to on page 10.

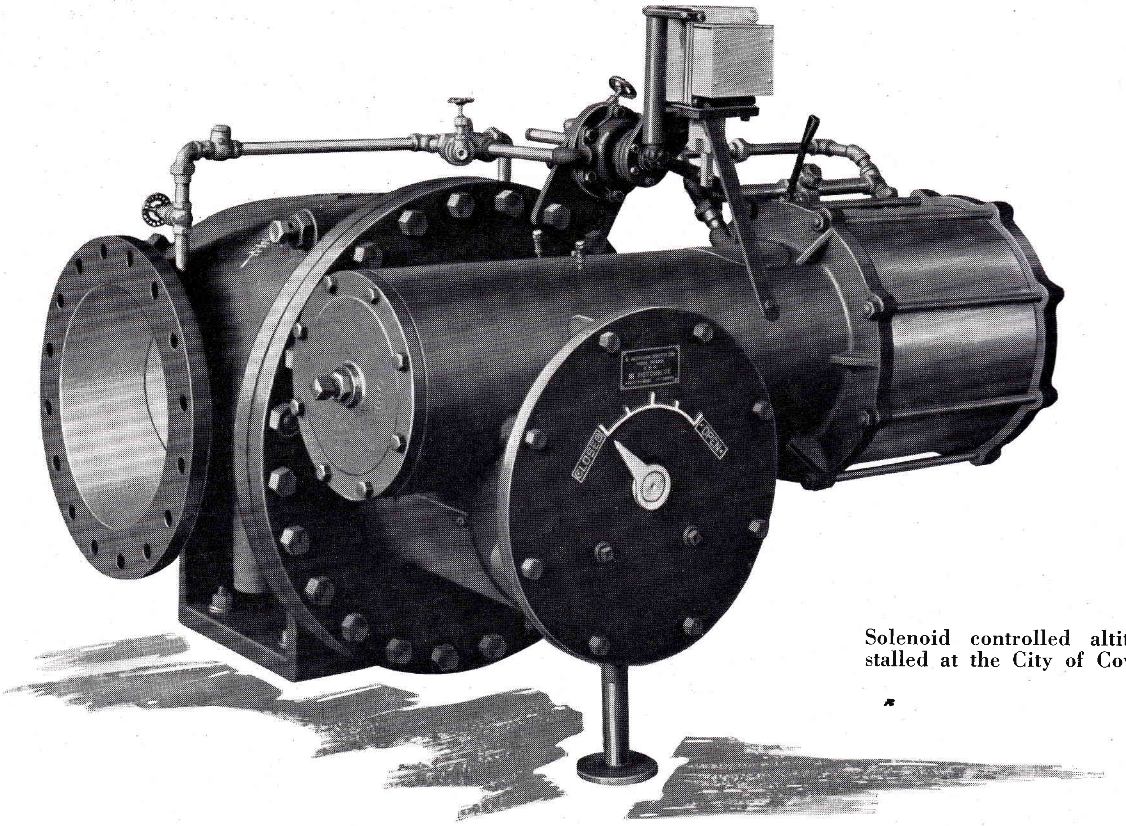
Altitude controls are divided into two main classifications: Hydraulic and Electric.

The controls of the hydraulic classification function by means of one or more weight loaded diaphragms which are connected to the stem or stems of a pilot valve or valves. The diaphragms are sensitive to the line or tank pressures. These controls are shown on pages 37 and 41.

The controls of the electric classification function through a float or pressure switch or other similar device which in turn energizes a solenoid operated pilot valve. The plug is then actuated by a hydraulic cylinder. A motor operated valve may also be used in connection with any of the aforementioned electrical devices.

The most accurate and dependable altitude valves under high heads are operated by electrical means. This is preferable wherever possible.

The drawings and descriptions on pages 43, 44 and 45 cover some of the installation possibilities of altitude valves.

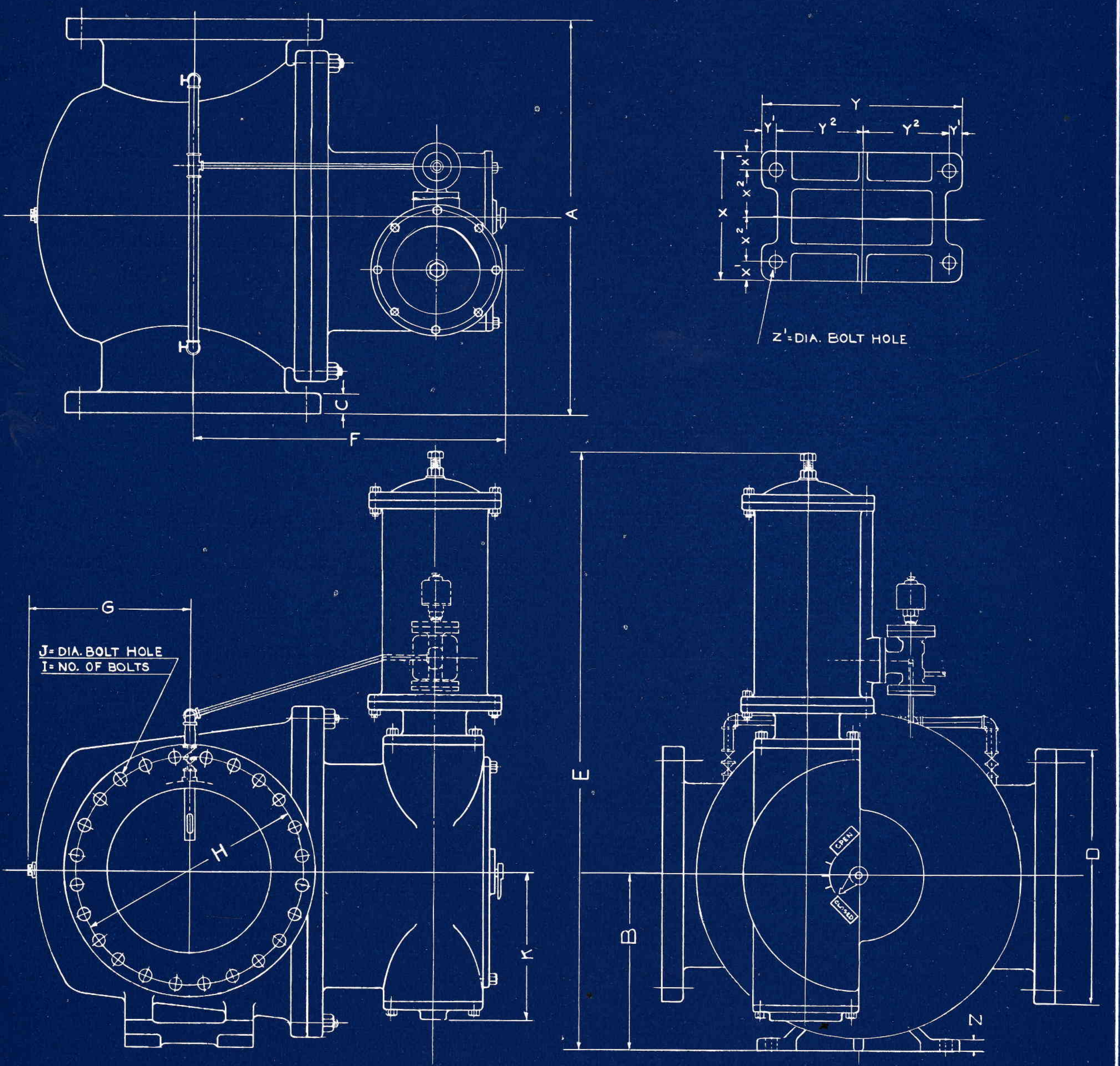


Solenoid controlled altitude valve installed at the City of Covington, Ky.

STANDARD 125 LBS. OPERATING PRESSURE

Valve Size	A	B	C	D	E	F	G	H	I	J	K
6"	23 1/8"	9 1/2"	1"	11"	43"	23 3/4"	7 1/2"	9 1/2"	8	7/8"	11 3/8"
8"	23 1/2"	9 1/2"	1 1/8"	13 1/2"	43"	23 3/4"	8 3/4"	11 3/4"	8	7/8"	11 3/8"
10"	28 1/8"	12"	1 3/16"	16"	45 1/2"	25 1/4"	11 1/2"	14 1/4"	12	1"	11 3/8"
12"	31"	14"	1 1/4"	19"	53 7/8"	28 3/4"	12 1/2"	17"	12	1"	12 7/8"
14"	35 1/2"	15 1/2"	1 3/8"	21"	55 3/8"	29 3/4"	13 1/4"	18 3/4"	12	1 1/8"	12 7/8"
16"	39"	17 1/8"	1 7/16"	23 1/2"	63 5/8"	33 3/4"	15 1/2"	21 1/4"	16	1 1/8"	15 7/8"
18"	41 3/4"	19 1/4"	1 9/16"	25"	65 3/4"	34 3/4"	17 3/4"	22 3/4"	16	1 1/4"	15 7/8"
20"	47"	22"	1 11/16"	27 1/2"	78 1/4"	40"	19 1/2"	25"	20	1 1/4"	20 1/2"
24"	56"	26"	1 7/8"	32"	82 1/4"	43 3/4"	21 1/4"	29 1/2"	20	1 3/8"	20 1/2"
30"	64"	30 1/2"	2 1/8"	38 3/4"	117 1/2"	57 3/4"	27"	36"	28	1 3/8"	31"
36"	70 1/2"	35"	2 3/8"	46"	122"	61"	28 1/2"	42 3/4"	32	1 5/8"	31"
42"	83 1/4"	43"	2 5/8"	53"	153 1/4"	75"	36"	49 1/2"	36	1 5/8"	37 3/4"
48"	93"	47 1/2"	2 3/4"	59 1/2"	157 3/4"	78 1/2"	40 1/2"	56"	44	1 5/8"	37 3/4"
54"	101"	54"	3"	66 1/4"	164 1/4"	81 1/2"	47 1/2"	62 3/4"	44	1 7/8"	50"
60"	111"	61"	3 1/8"	73"	171 1/4"	84 1/2"	51 1/2"	69 1/4"	52	1 7/8"	50"

	STANDARD 125 LBS. OPERATING PRESSURE								250 LBS. OPERATING PRESSURE					
Valve Size	X	X^1	X^2	Y	Y^1	Y^2	Z	Z^1	A	C	D	H	I	J
6"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	24"	1 7/16"	12 1/2"	10 5/8"	12	7/8"
8"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	24 1/2"	1 5/8"	15"	13"	12	1"
10"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	29 1/2"	1 7/8"	17 1/2"	15 1/4"	16	1 1/8"
12"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	32 1/2"	2"	20 1/2"	17 3/4"	16	1 1/4"
14"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	37"	2 1/8"	23"	20 1/4"	20	1 1/4"
16"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	41"	2 1/4"	25 1/2"	22 1/2"	20	1 3/8"
18"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	43 3/8"	2 3/8"	28"	24 3/4"	24	1 3/8"
20"	20"	2"	8"	31 1/2"	1 3/4"	14"	1 3/4"	1 3/4"	48 5/8"	2 1/2"	30 1/2"	27"	24	1 3/8"
24"	20"	2"	8"	31 1/2"	1 3/4"	14"	1 3/4"	1 3/4"	57 3/4"	2 3/4"	36"	32"	24	1 5/8"
30"	30"	5"	10"	30"	2 1/2"	12 1/2"	1 1/2"	2 1/4"	65 3/4"	3"	43"	39 1/4"	28	1 7/8"
36"	35 1/2"	4 1/4"	13 1/2"	36"	3"	15"	1 1/2"	2 1/4"	74"	3 3/8"	50"	46"	32	2 1/4"
42"	42"	5 1/2"	15 1/2"	42"	4"	17"	2 1/4"	2 5/8"	85 3/8"	3 11/16"	57"	52 3/4"	36	2 1/4"
48"	54"	6"	21"	54"	6"	21"	2 1/2"	2 5/8"	95 1/2"	4"	65"	60 3/4"	40	2 1/4"
54"	54"	6"	21"	54"	6"	21"	2 3/4"	2 3/4"			SPECIAL			
60"	60"	9"	21"	60"	9"	21"	2 3/4"	3"			SPECIAL			



OUTLINE DRAWING OF STANDARD HYDRAULIC ROTOVALVE
WITH SOLENOID ALTITUDE CONTROL AND CYLINDER VERTICAL.

APPLICATION OF ALTITUDE CONTROLS

ALTITUDE systems are of two types: One-Way and Two-Way.

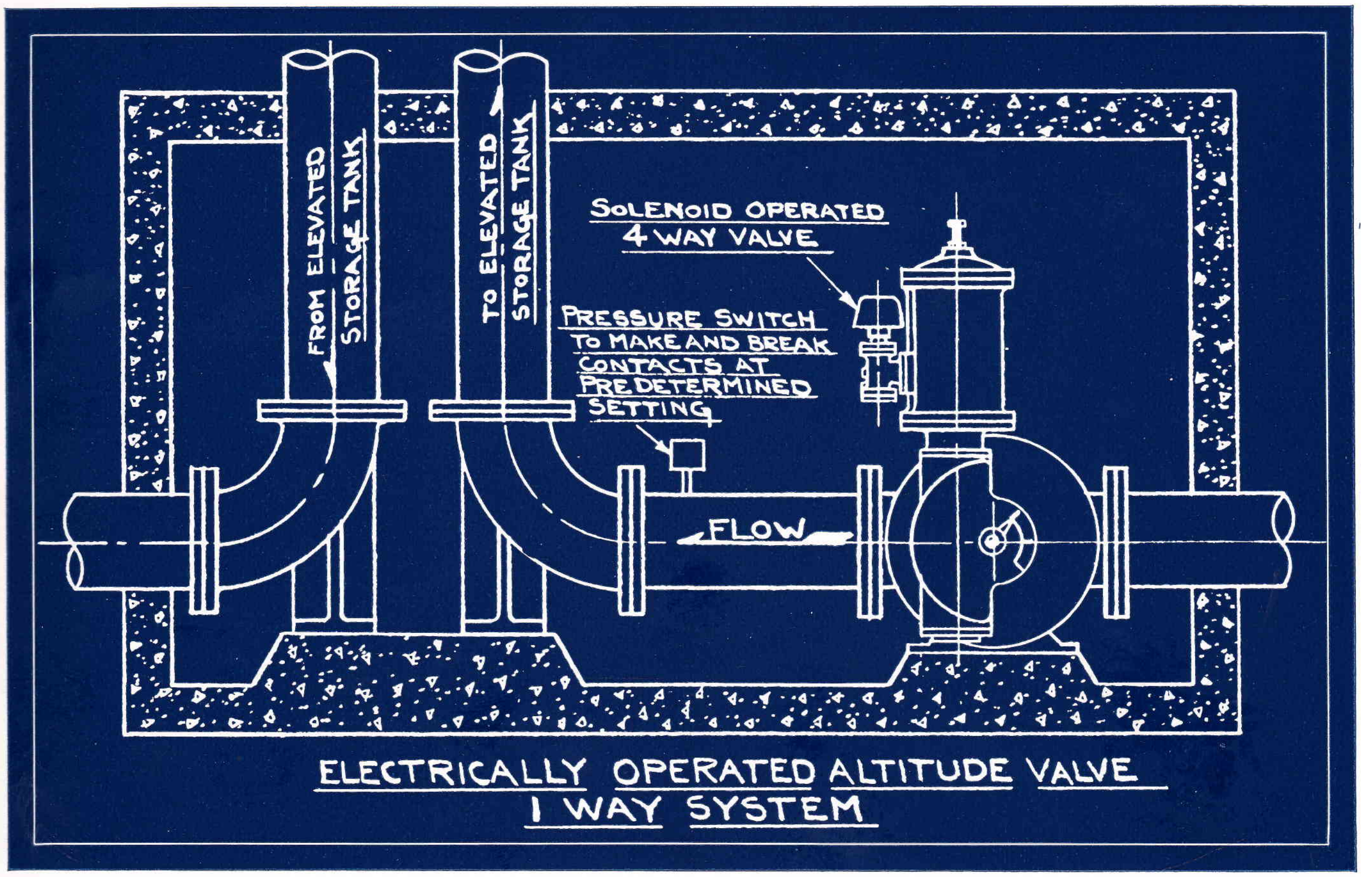
In the One-Way system water flows into a tank through *one* pipe and is emitted through *another*. For this system, two methods of control are available. In the first method the control opens the valve when the level in the tank drops below a predetermined point and closes the valve when the tank is filled. This method is not sensitive to line pressure and is dependent entirely upon the elevation in the tank. The second method employs a dual control which responds to the pressure on the supplying system when the pressure is higher than the tank level. One unit of the dual control functions to open the ROTOVALVE which then acts as a pressure relief valve and admits water to the tank. When the tank is filled, the second unit closes the valve regardless of the pressure in the supplying line. This unit also permits refilling the tank whenever pumping capacity is available without waiting until all storage capacity is exhausted before starting the cycle of refilling.

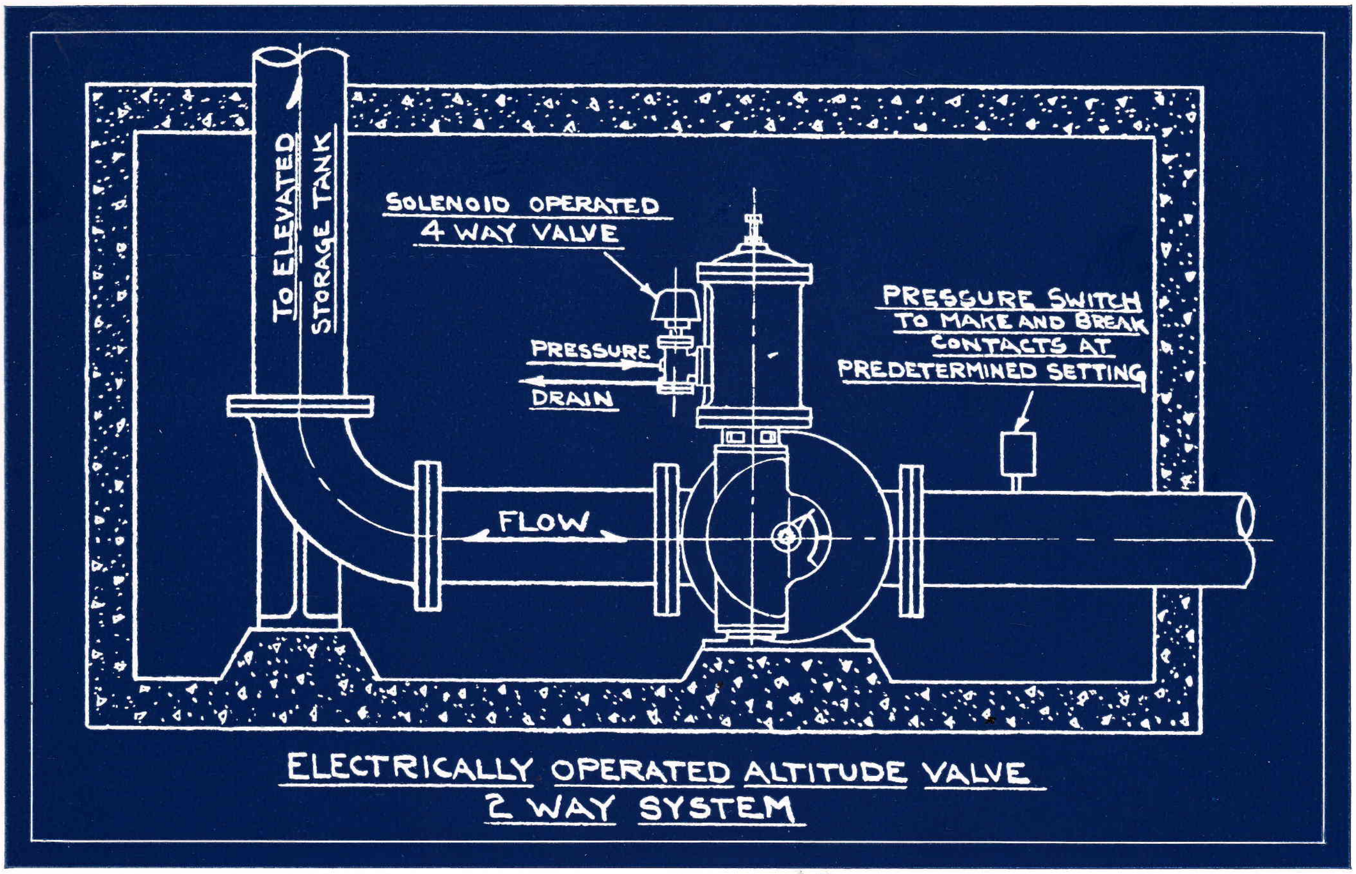
In the Two-Way system, water flows into and out of the tank through the same valve. For this system two methods of control are also available. In the first method a control designed to close the valve when the tank is filled is used. When a period of demand occurs and the line pressure drops below a predetermined point, the valve opens completely to supply the demand and remains open until the tank is again filled.

The second method utilizes a compound control. Upon filling the tank, the valve closes. If the line pressure drops to a predetermined low point, the valve opens only an amount sufficient to maintain pressure in the line at the minimum point. As the demand decreases and the line pressure rises, the valve remains open until the tank is again filled. Should the pressure in the line decrease below the tank pressure during the operation of filling, the valve will close completely until the pipe line pressure has been reestablished to allow continuation of filling or until this pressure has fallen to a predetermined low. Under this condition the valve will again open to maintain a minimum pressure in the line.

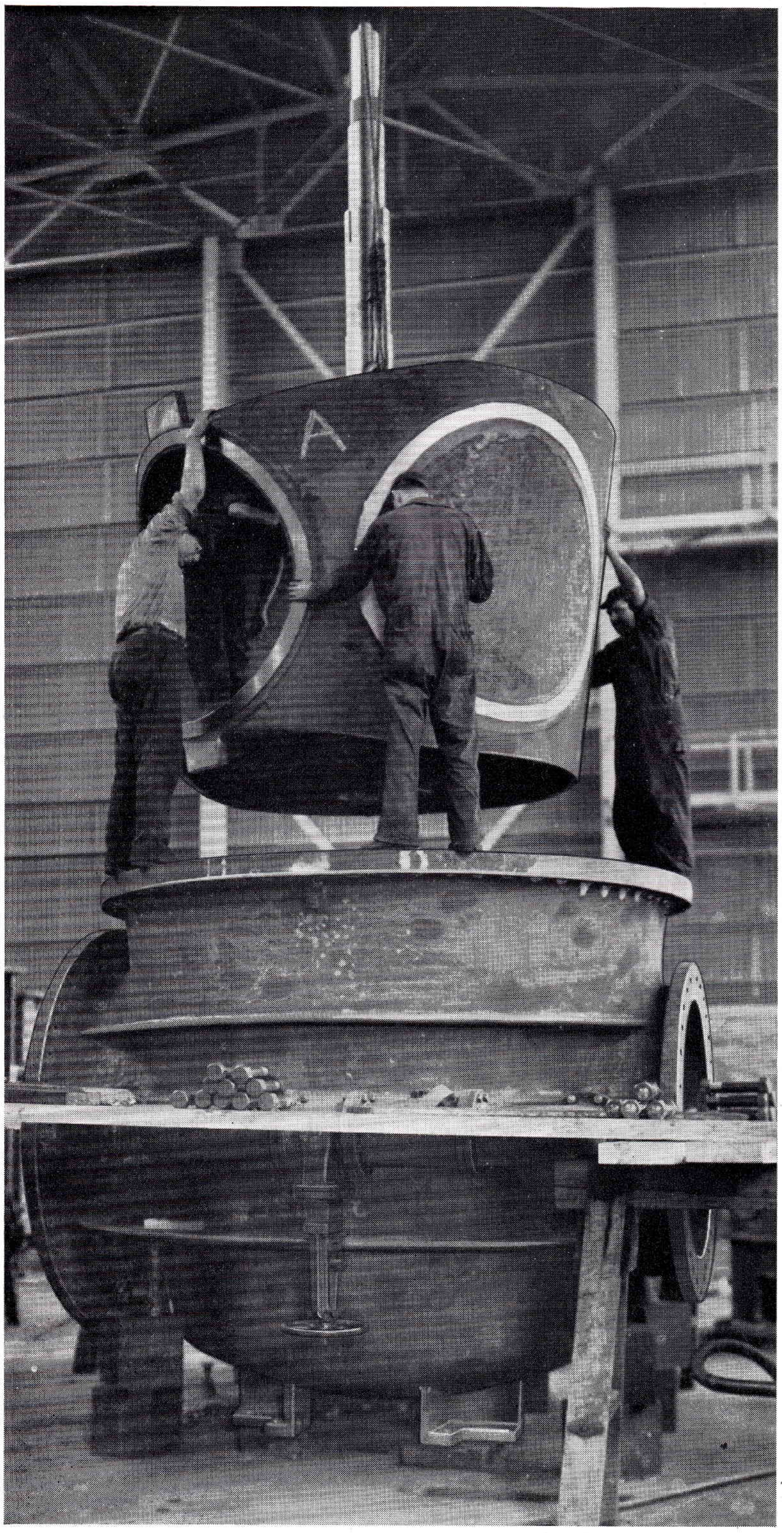
In addition to the hydraulic methods described above, electrical controls may be used. By using a standard electrical pressure switch and a solenoid mounted on the control, shown opposite, the energizing of the solenoid will normally open the valve and de-energizing will close it.

The use of electrical controls for high heads is recommended where greater accuracy is desired than can be obtained by a diaphragm control. By using a float switch or a pressure switch located near the shut-off elevation of the tank, great accuracy can be obtained. These switches should be protected from freezing.


FROM ELEVATED
STORAGE TANK
TO ELEVATED
STORAGE TANK
SOLENOID OPERATED
4 WAY VALVE
PRESSURE SWITCH
TO MAKE AND BREAK
CONTACTS AT
PREDETERMINED
SETTING
FLOW
ELECTRICALLY OPERATED ALTITUDE VALVE
1 WAY SYSTEM


TO ELEVATED
STORAGE TANK
SOLENOID OPERATED
4 WAY VALVE
PRESSURE
DRAIN
PRESSURE SWITCH
TO MAKE AND BREAK
CONTACTS AT
PREDETERMINED SETTING
FLOW
ELECTRICALLY OPERATED ALTITUDE VALVE
2 WAY SYSTEM

Emergency Line Check Valves



Assembling a large ROTOVALVE in the factory.

HYDRAULICALLY operated emergency check valves have been developed to cope with situations arising from rupture of flow lines or force mains. Such protection should be available at strategic points in order to prevent drainage of a system. Examples of such points are river crossings or flood areas. Thickly populated areas such as business or residential districts should also be protected.

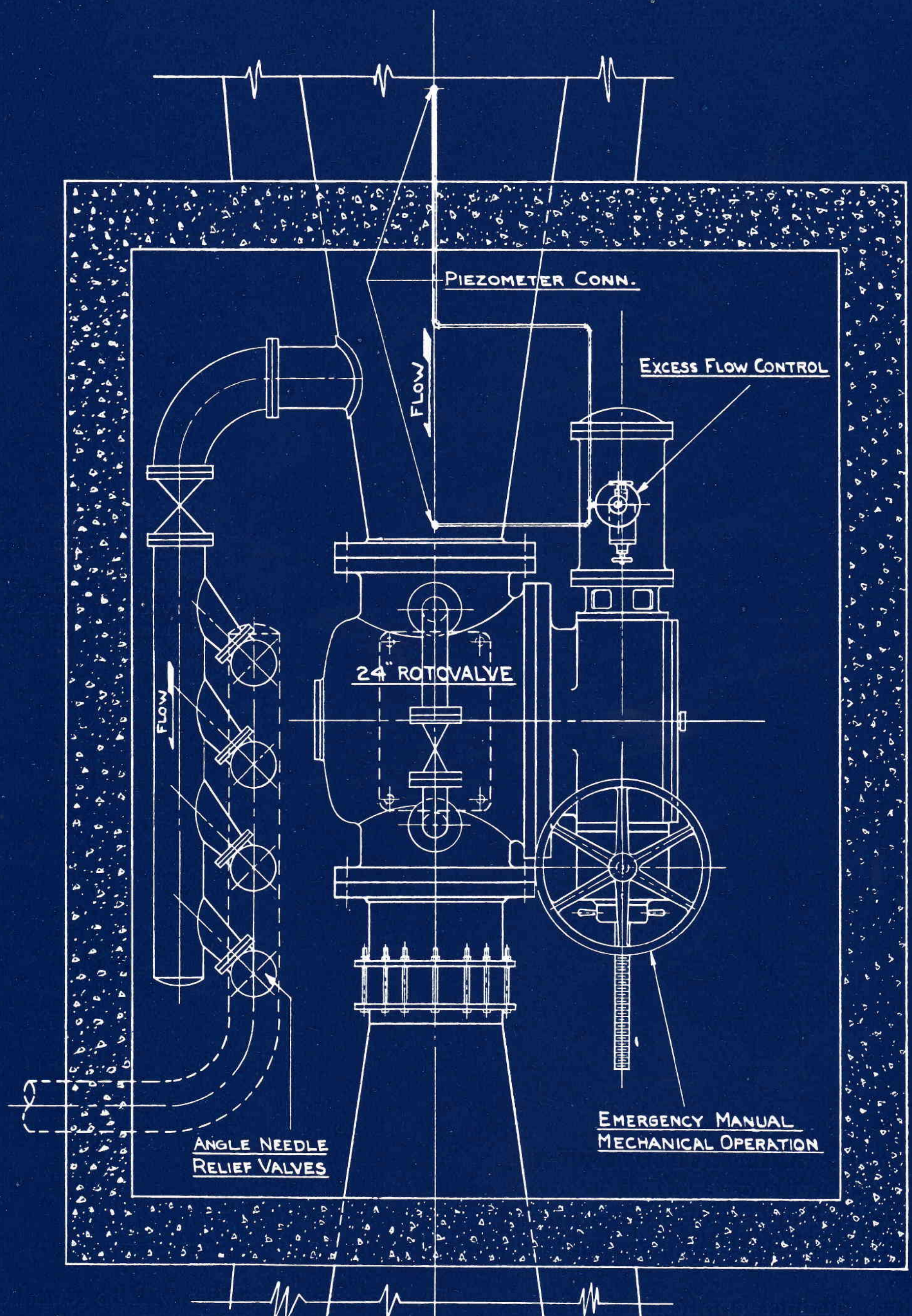
Although referred to as check valves their controls differ from those of the standard check type in that they are actuated by predetermined excess velocity in one direction only, or in either direction as the circumstances require. Many installations of this nature have been made and found practical.

All emergency line check valves may be provided with auxiliary manual mechanical means of operation as referred to on pages 24 and 25.

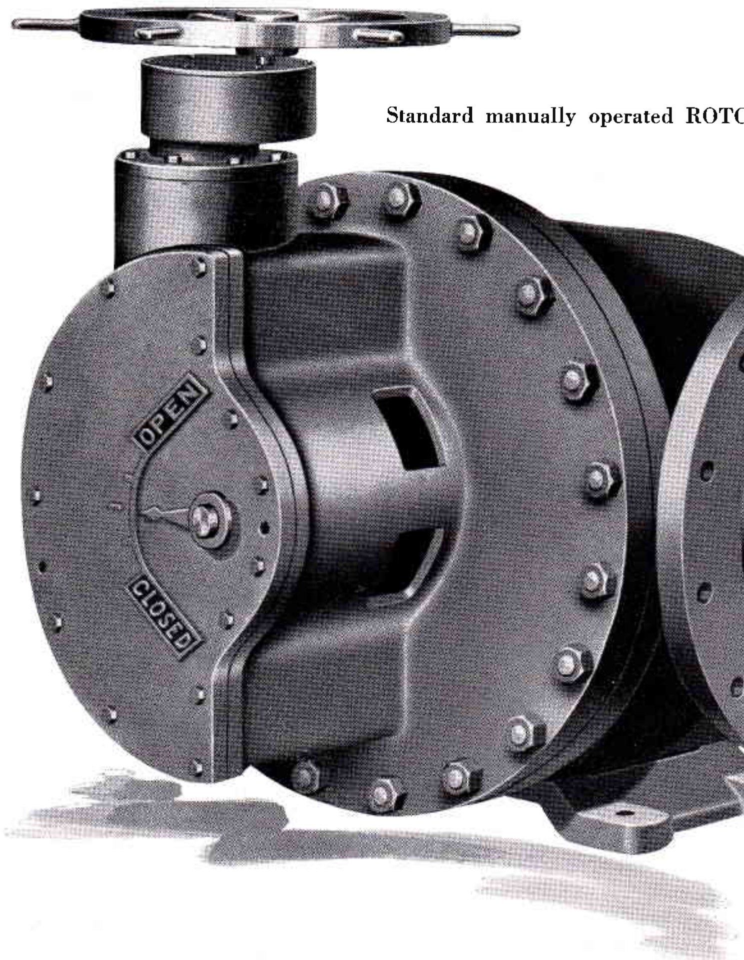
Emergency line check valves operate at higher speeds than pressure relief or pressure reducing valves. Therefore, they should be installed in conjunction with Angle Needle relief valves to relieve the line from excess pressure rise due to the speed of emergency closure.

A major break in a pipe line might deprive the valve of sufficient water pressure for operation. In such cases, oil or water accumulator systems have been installed to meet this condition. A careful study of the pipe line gradients will determine the proper application.

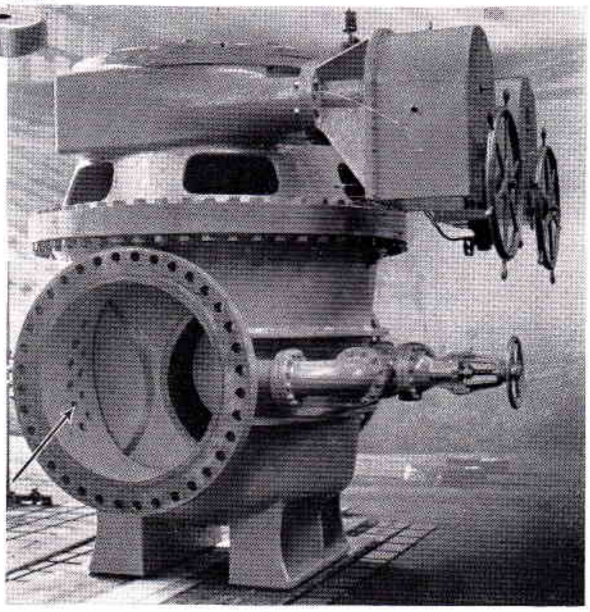
Outline dimension drawings are shown on pages 16 to 19 inclusive. Page 47 shows a typical installation.



TYPICAL INSTALLATION OF EMERGENCY LINE CHECK VALVE
WITH AUXILIARY MECHANICAL MANUAL CONTROL
SHOWING ANGLE NEEDLE RELIEF VALVES.



Standard manually operated ROTOVALVE.



Manually operated reseating throttle valve for Colorado River Aqueduct, Palos Verdes Feeder. This photograph shows a vacuum breaker section as indicated by the arrow.

Manual Stop Valves

MANUAL stop valves of the ROTOVALVE design are being used quite extensively not only in pipe line and distribution work in new projects, but as replacements in the revamping of existing systems.

There are two distinct applications of the manual stop valve. One is designed primarily to completely shut-off the line and is normally either in the full open or fully closed position. The other is especially constructed so it may be used as a throttling valve and is usually set in some intermediate position for indefinite periods.

Standard stop valves for shut-off purposes *only* have a single operating stem as referred to in the section drawings found on pages 50 and 51. Various assemblies will be found on page 54 and an outline dimension drawing appears on page 56.

Special *stop valves* for both *shut-off* and *throttling* purposes have double operating stems—one used for lifting the plug off its seat, the other for rotating it to any intermediate position where it is reseated. Such valves, designated as reseating valves, are referred to on pages 52 53, 55 and 57.

Both types can be arranged for burial in the

ground without vaults by simple changes in the operating heads. When buried, all of the operating mechanism is submerged in an oil bath and the operating head is so designed that foreign material cannot possibly enter. In addition, the hand hole normally used in connection with the packing gland of the plug shaft is fitted with a gasket and plate.

The oil used in the valve head for valves when buried is of low quality and medium viscosity and may be procured at an additional charge. To repack or tighten the plug shaft gland, it is not necessary to drain the oil from the head and leakage from the gland cannot enter it.

If valves are to be buried, it must be so stated at time of purchase.

The reseating valve bodies are provided with an integrally cast manifold on the downstream section as referred to on page 34. The purpose of this manifold is to water vent the vacuum areas where cavitation might occur.

Free discharge valves come under the same classification as manual reseating valves. They are specifically covered on page 62.

On pages 54 and 55 the various assemblies of manually operated valves will be found.

Valves for 125 lbs. pressure above 18 inches will be equipped with gear boxes irrespective of type.

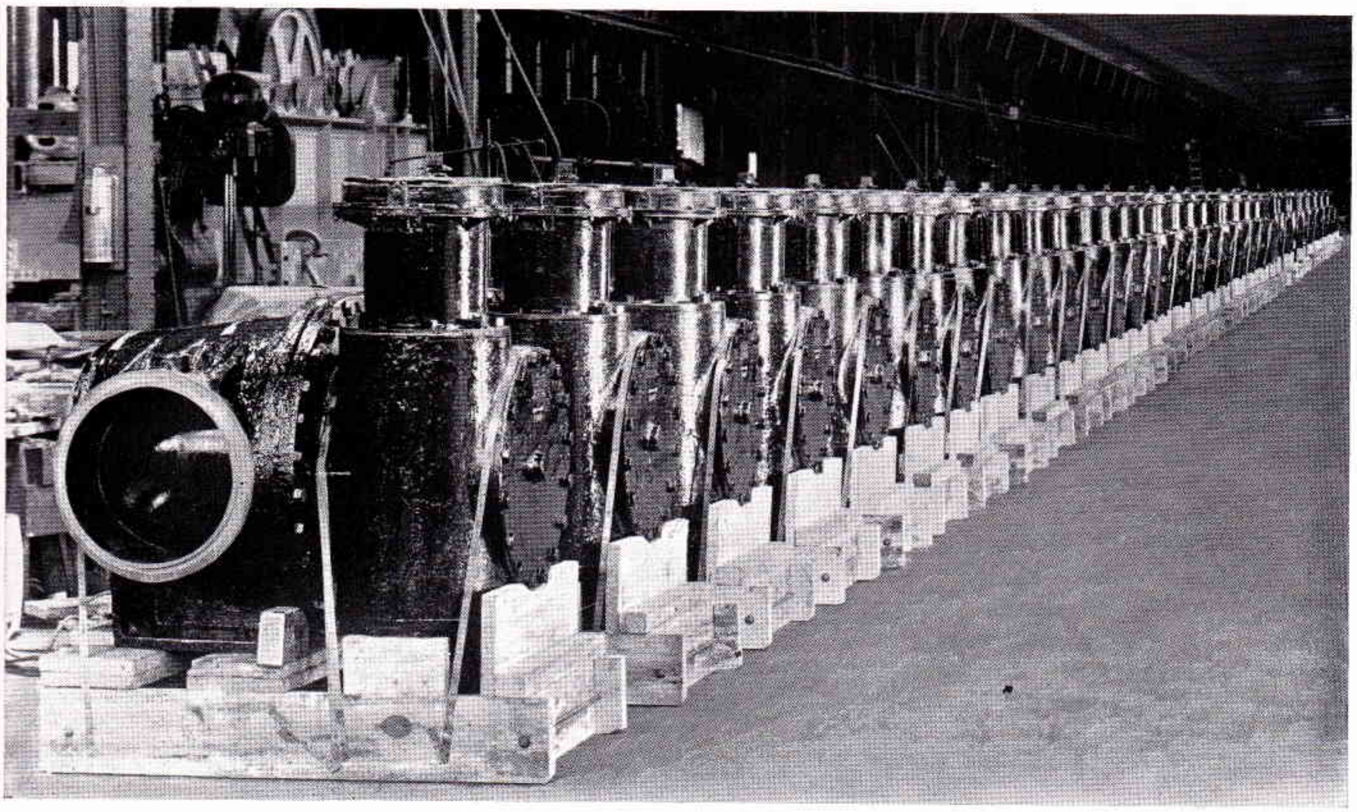
Valves for 250 lbs. pressure above 10 inches will be equipped with gear boxes.

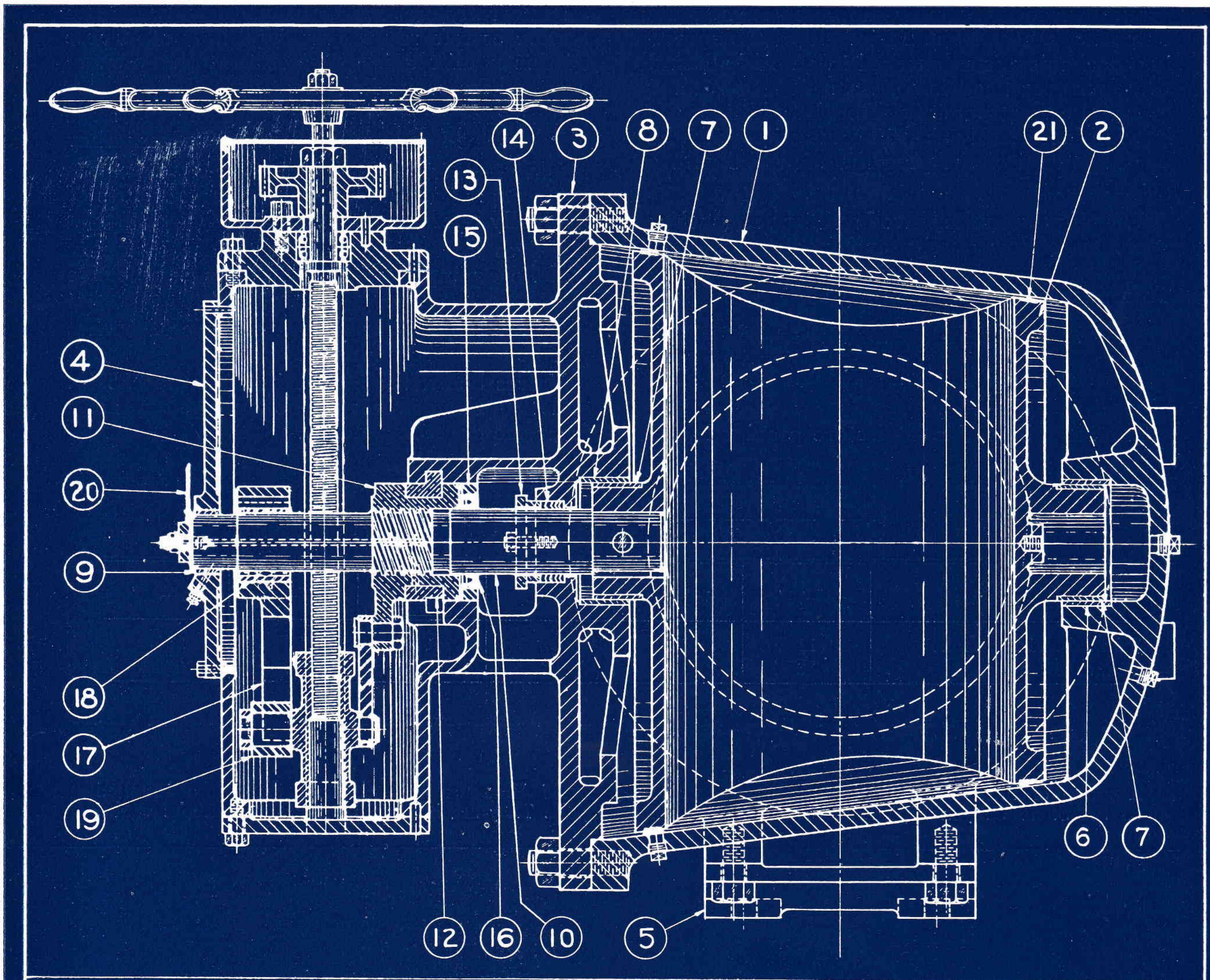
Valves below these sizes in both the 125 lb. and 250 lb. classes will be operated directly from the operating stems.

OIL REQUIREMENTS IN GALLONS

Valve Sizes	6″–10″	12″–14″	16″–18″	20″–24″	30″–36″	42″–48″
Manual and Hydraulic	11	12	22	39	125	265
Manual Reseating	12	14	28	34	120	265

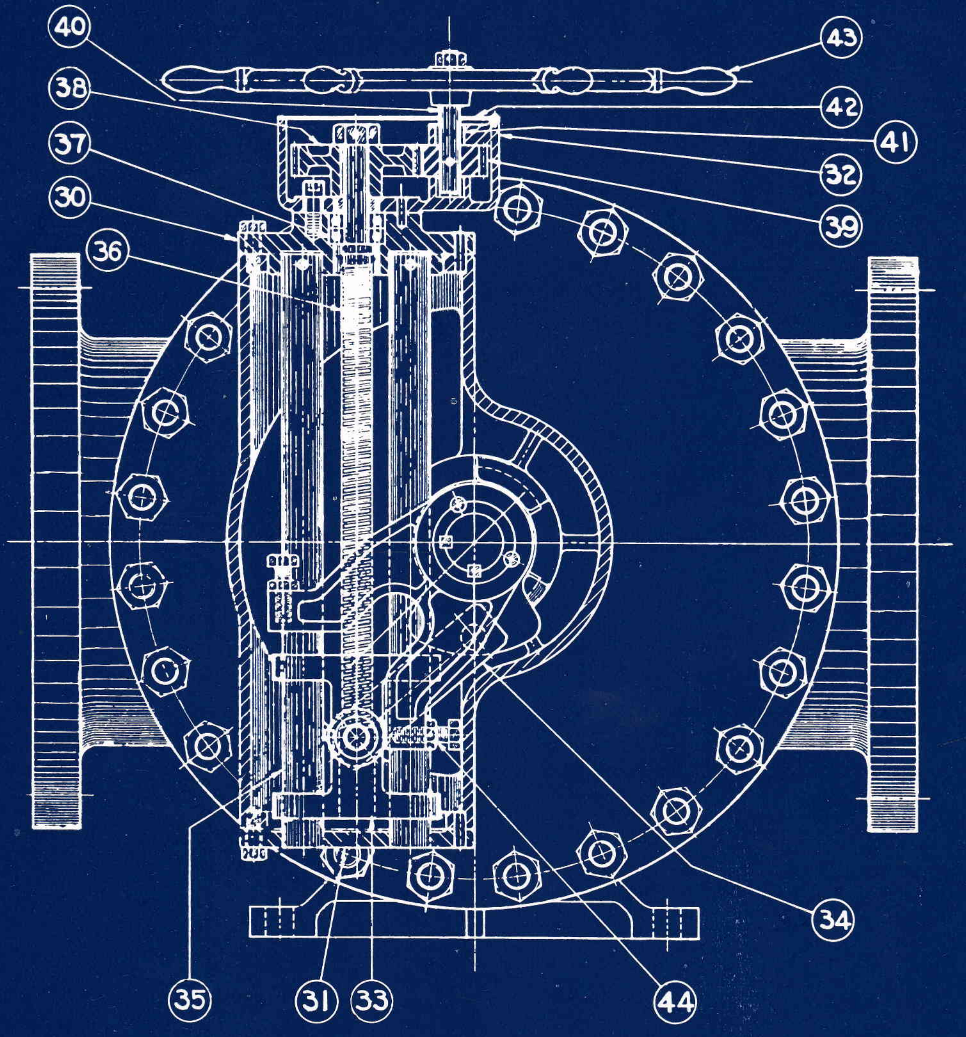
A group of thirty-seven 20″ high pressure manually operated Roto-stop valves. These valves are installed on the Stone Canyon Pipe Line for the City of Los Angeles. They are buried in the ground without vaults.





No.	Part Name	125 lb. Standard Material	125 lb. Standard Specification	250 lb. Standard Material	250 lb. Standard Specification
1	Body	Cast Iron	ASTM A48-36 No. 40	Cast Steel	ASTM A27-36T Grade "B"
2	Plug	Cast Iron	ASTM A48-36 No. 40	Cast Steel	ASTM A27-36T Grade "B"
3	Head	Cast Iron	ASTM A48-36 No. 40	Cast Steel	ASTM A27-36T Grade "B"
4	Cover	Cast Iron	ASTM A48-36 No. 40	Cast Iron	ASTM A48-36 No. 40
5	Base	Cast Iron	ASTM A48-36 No. 40	Cast Iron	ASTM A48-36 No. 40
6	Body Bushing	Bronze	ASTM B74-32T	Bronze	ASTM B74-32T
7	Plug Bushing	Bronze	ASTM B60-36	Bronze	ASTM B60-36
8	Head Bushing	Bronze	ASTM B74-32T	Bronze	ASTM B74-32T
9	Cover Bushing	Bronze	ASTM B60-36	Bronze	ASTM B60-36
10	Plug Shaft	Bronze	Hy-Ten Forging	Bronze	Hy-Ten Forging
11	Lifter Lever	Mang. Brz.	ASTM B54-27	Mang. Brz.	ASTM B54-27
12	Breech Lock	Mang. Brz.	ASTM B54-27	Mang. Brz.	ASTM B54-27
13	Packing Gland	Bronze	ASTM B60-36	Bronze	ASTM B60-36
14	Packing	Chevron		Chevron	
15	Seal Cage	Steel		Steel	
16	Oil Seal	"Klozure"	Garlock	"Klozure"	Garlock
17	Rotator Lever	Cast Steel	Alloy Steel	Cast Steel	Alloy Steel
18	Rotator Sleeve	Steel	Mach'y Steel	Steel	Mach'y Steel
19	Roller	Stainless Steel		Stainless Steel	
20	Pointer	Bronze		Bronze	
21	Seat Rings	Monel		Monel or Everdur	

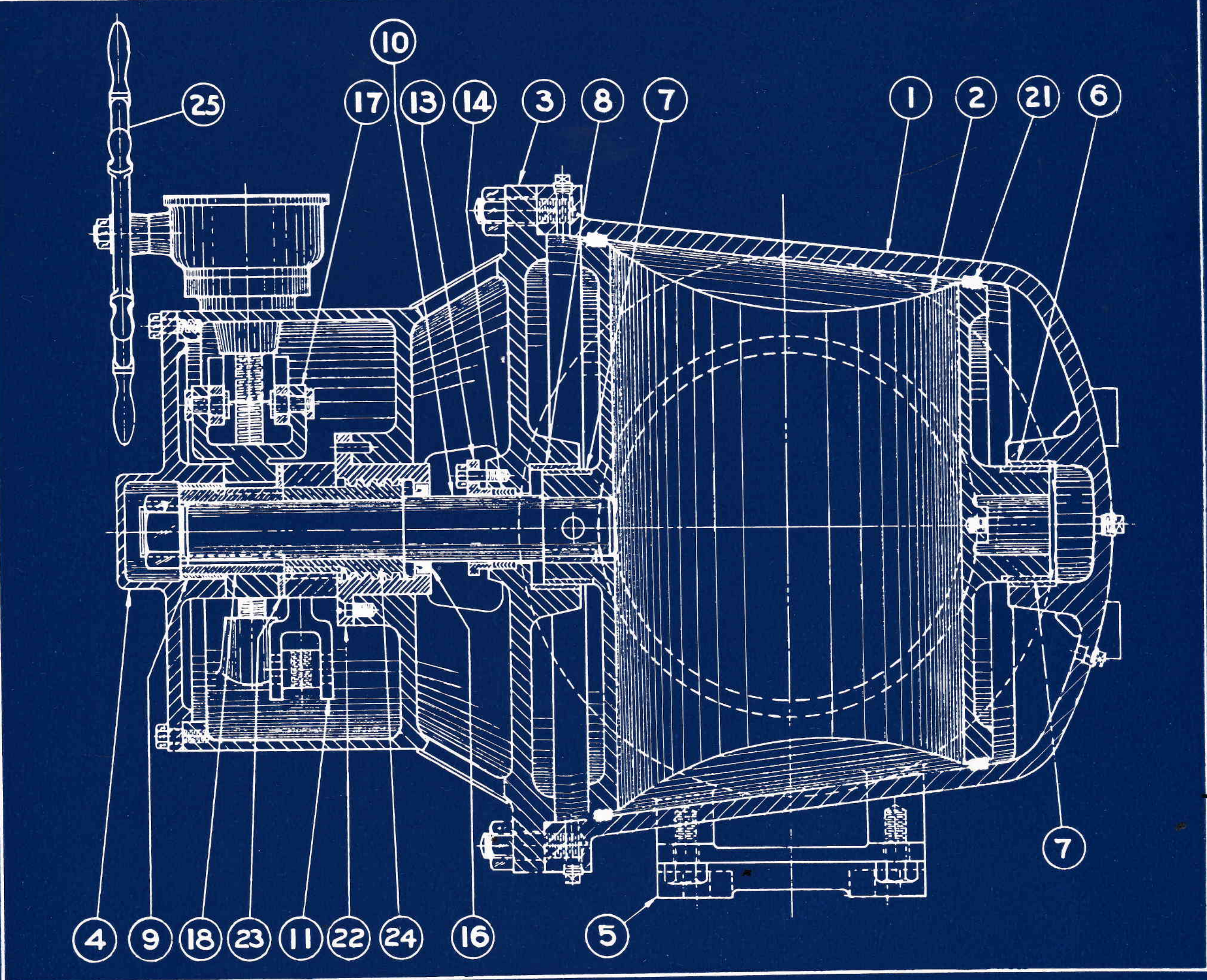
SECTIONAL ASSEMBLY OF STANDARD MANUAL ROTOVALVE.



		125 lb. Standard		250 lb. Standard	
No.	Part Name	Material	Specification	Material	Specification
30	Bearing Housing	Cast Iron	ASTM A48-36 No. 40	Cast Steel	ASTM A27-36T Grade "B"
31	End Bearing	Cast Iron	ASTM A48-36 No. 40	Cast Iron	ASTM A48-36 No. 40
32	Gear Housing	Cast Iron	ASTM A48-36 No. 40	Cast Iron	ASTM A48-36 No. 40
33	Cross Head	Mang. Brz.	ASTM B54-27	Mang. Brz.	ASTM B54-27
34	Link	Brass		Brass	
35	Guide Rods	Bronze	Hy-Tensile	Bronze	Hy-Tensile
36	Screw Stem	Bronze	Hy-Tensile	Bronze	Hy-Tensile
37	Thrust Bearing		Duplex Annular Contact		Duplex Annular Contact
38	Spur Gear	Cast Iron	ASTM A48-36 No. 40	Cast Iron	ASTM A48-36 No. 40
39	Pinion	Steel		Steel	
40	Pinion Shaft	Steel		Steel	
41	Bushings	Bronze	ASTM B60-36	Bronze	ASTM B60-36
42	Gear Cover	Sheet Steel		Sheet Steel	
43	Hand Wheel	Cast Iron	ASTM A48-36 No. 40	Cast Iron	ASTM A48-36 No. 40
44	ADJ. Screws	Steel		Steel	

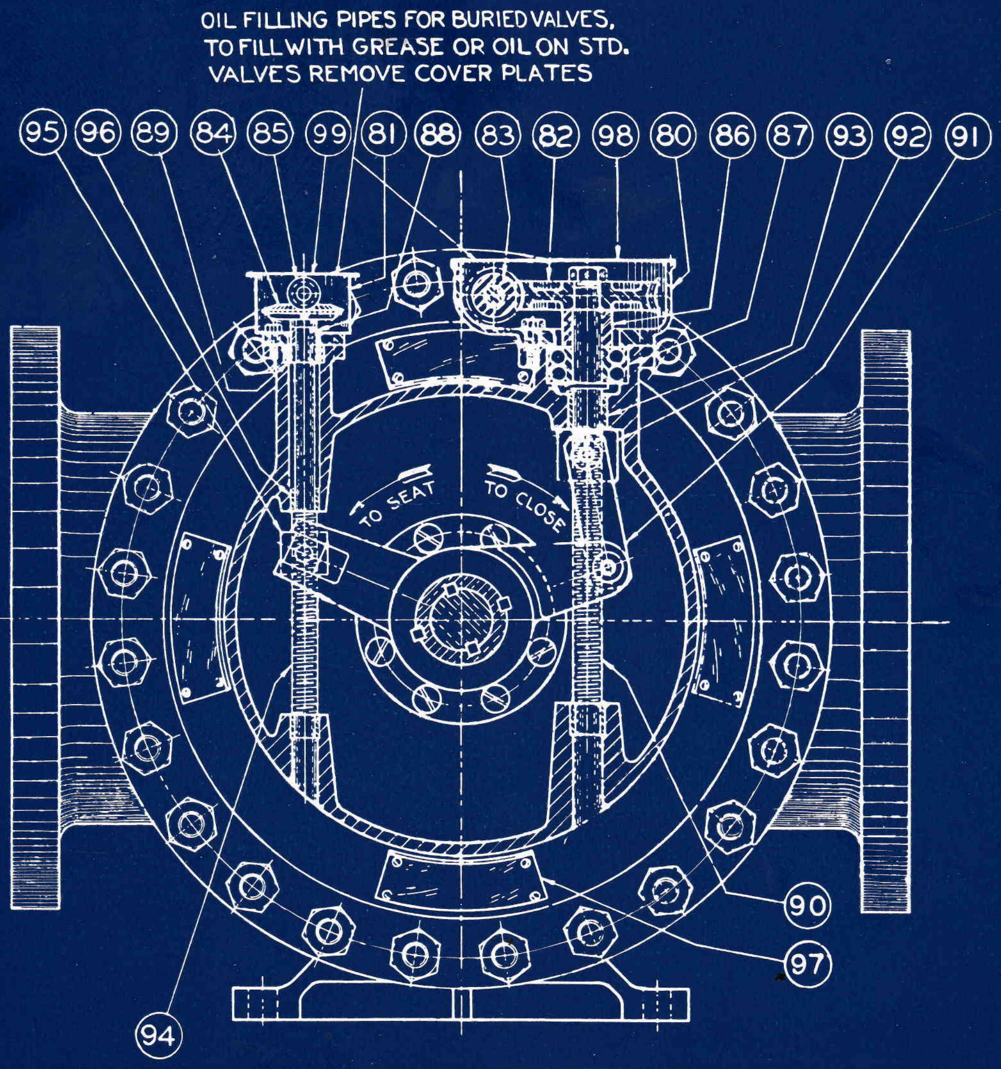
FRONT VIEW ASSEMBLY OF STANDARD MANUALLY OPERATED ROTOVALVE.

		125 lb. Standard		250 lb. Standard	
No:	Part Name	Material	Specification	Material	Specification
1	Body	Cast Iron	ASTM A48-36 No. 40	Cast Steel	ASTM A27-36T Grade "B"
2	Plug	Cast Iron	ASTM A48-36 No. 40	Cast Steel	ASTM A27-36T Grade "B"
3	Head	Cast Iron	ASTM A48-36 No. 40	Cast Steel	ASTM A27-36T Grade "B"
4	Cover	Cast Iron	ASTM A48-36 No. 40	Cast Iron	ASTM A48-36 No. 40
5	Base	Cast Iron	ASTM A48-36 No. 40	Cast Iron	ASTM A48-36 No. 40
6	Body Bushing	Bronze	ASTM B74-32T	Bronze	ASTM B74-32T
7	Plug Bushing	Bronze	ASTM B60-36	Bronze	ASTM B60-36
8	Head Bushing	Bronze	ASTM B74-32T	Bronze	ASTM B74-32T
9	Cover Bushing	Bronze	ASTM B60-36	Bronze	ASTM B60-36
10	Plug Shaft	Bronze	Hy-Ten Forging	Bronze	Hy-Ten Forging
11	Lifter Lever	Cast Steel	ASTM A27-36T Grade "B"	Cast Steel	ASTM A27-36T Grade "B"
13	Packing Gland	Bronze	ASTM B60-36	Bronze	ASTM B60-36
14	Packing	Chevron		Chevron	
16	Oil Seal	"Klozure"	Garlock	"Klozure"	Garlock
17	Rotator Lever	Cast Steel	ASTM A27-36T Grade "B"	Cast Steel	ASTM A27-36T Grade "B"
18	Rotator Sleeve	Manganese Bronze	ASTM B54-27	Manganese Bronze	ASTM B54-27
21	Seat Rings	Monel		Monel or Everdur	
22	Lift Nut	Cast Iron	ASTM A48-36 No. 40	Cast Steel	ASTM A27-36T Grade "B"
23	Thrust Washer	Bronze	ASTM B60-36	Bronze	ASTM B60-36
24	Lift Screw	Manganese Bronze	ASTM B54-27	Manganese Bronze	ASTM B54-27
25	Handwheel	Cast Iron	ASTM A48-36 No. 40	Cast Iron	ASTM A48-36 No. 40

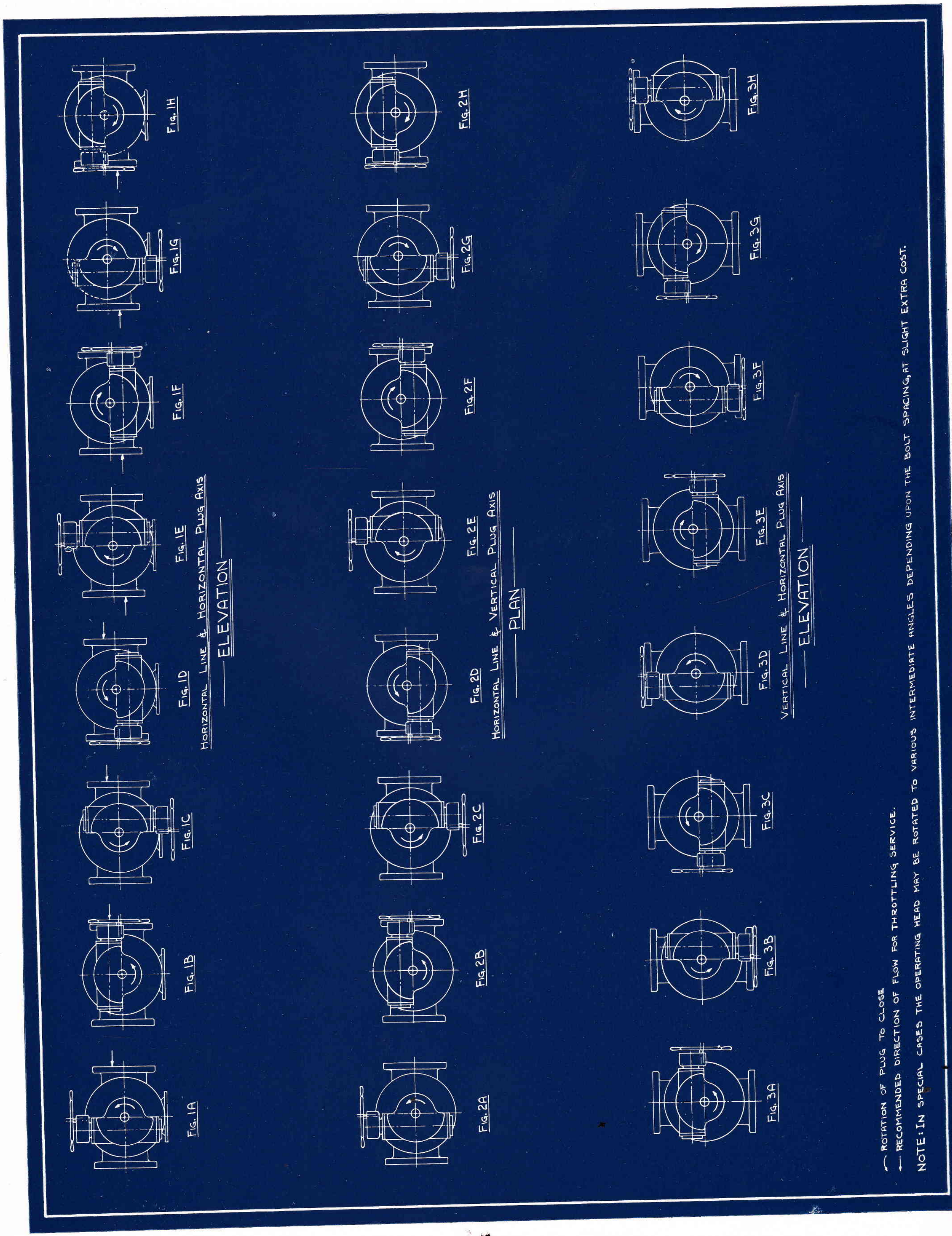


SECTIONAL ASSEMBLY OF STANDARD MANUAL RESEATING ROTOVALVE.

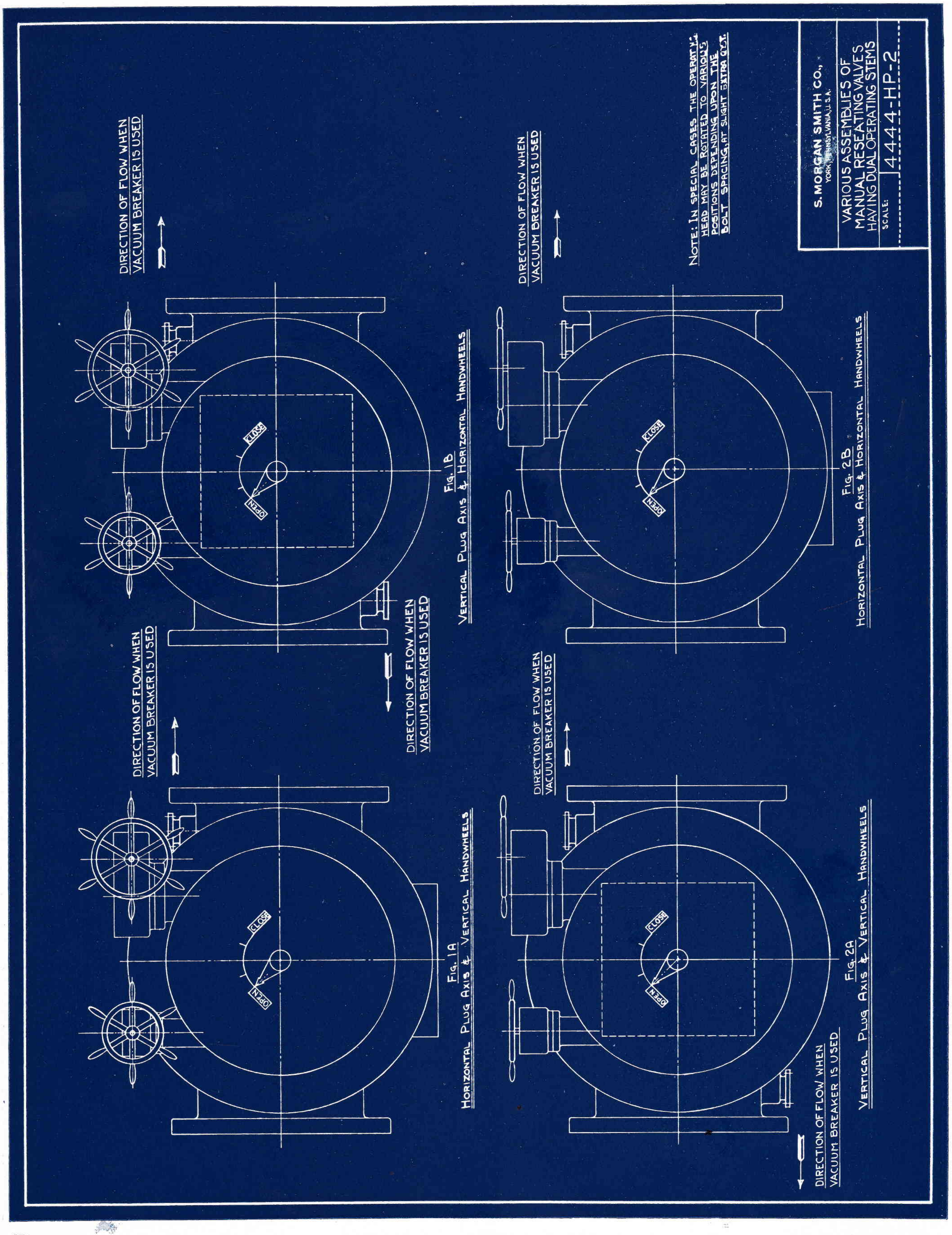
		125 lb. Standard		250 lb. Standard	
No.	Part Name	Material	Specification	Material	Specification
80	Rotator Gear Housing	Cast Iron	ASTM A48-36 No. 40	Cast Iron	ASTM A48-36 No. 40
81	Lifter Gear Housing	Pl. Steel		Pl. Steel	
82	Worm Gear	Cast Iron	ASTM A48-36 No. 40	Cast Iron	ASTM A48-36 No. 40
83	Worm	Bronze	Phosphor	Bronze	Phosphor
84	Bevel Gear	Cast Iron	ASTM A48-36 No. 40	Cast Iron	ASTM A48-36 No. 40
85	Pinion	Steel		Steel	
86	Thrust Collar	Steel		Steel	
87	Thrust Bearing		Annular Contact		Annular Contact
88	Thrust Collar	Steel		Steel	
89	Thrust Bearing		Annular Contact		Annular Contact
90	Rotator Screw Stem	Steel	S.A.E. 1020	Steel	S.A.E. 1020
91	Link	Brass		Brass	
92	Crosshead	Mang. Brz.	ASTM B54-27	Mang. Brz.	ASTM B54-27
93	Bushings	Bronze	ASTM B60-36	Bronze	ASTM B60-36
94	Lifter Screw Stem	Steel	S.A.E. 1020	Steel	S.A.E. 1020
95	Crosshead	Mang. Brz.	ASTM B54-27	Mang. Brz.	ASTM B54-27
96	Bushings	Bronze	ASTM B60-36	Bronze	ASTM B60-36
97	Cover Plates	Pl. Steel		Pl. Steel	
98	Gear Cover	Pl. Steel		Pl. Steel	
99	Gear Cover	Pl. Steel		Pl. Steel	



FRONT VIEW ASSEMBLY OF STANDARD MANUAL RESEATING ROTOVALVE.



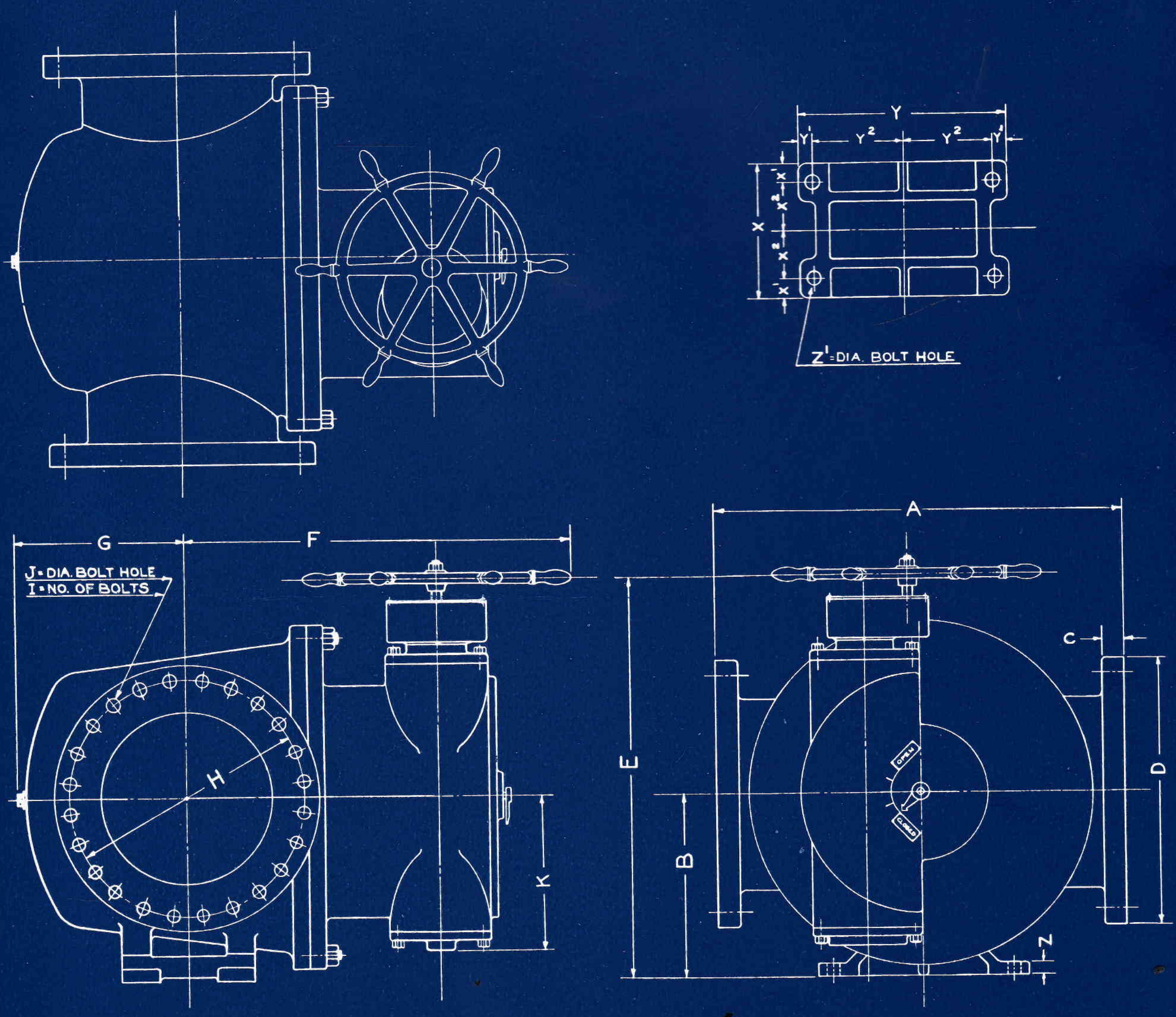
VARIOUS ASSEMBLIES OF MANUALLY OPERATED VALVES
WITH SINGLE OPERATING STEM.



VARIOUS ASSEMBLIES OF MANUAL RESEATING VALVES
WITH DUAL OPERATING STEMS.

STANDARD 125 LBS. OPERATING PRESSURE											
Valve Size	A	B	C	D	E	F	G	H	I	J	K
6"	23 1/8"	9 1/2"	1"	11"	23 1/4"	25 1/8"	7 1/2"	9 1/2"	8	7/8"	11 3/8"
8"	23 1/2"	9 1/2"	1 1/8"	13 1/2"	23 1/4"	25 1/8"	8 3/4"	11 3/4"	8	7/8"	11 3/8"
10"	28 1/8"	12"	1 3/16"	16"	25 3/4"	26 5/8"	11 1/2"	14 1/4"	12	1"	11 3/8"
12"	31"	14"	1 1/4"	19"	32 1/2"	33 7/8"	12 1/2"	17"	12	1"	12 7/8"
14"	35 1/2"	15 1/2"	1 3/8"	21"	34"	34 7/8"	13 1/4"	18 3/4"	12	1 1/8"	12 7/8"
16"	39"	17 1/8"	1 7/16"	23 1/2"	39"	39 1/2"	15 1/2"	21 1/4"	16	1 1/8"	15 7/8"
18"	41 3/4"	19 1/4"	1 9/16"	25"	41 1/8"	40 1/2"	17 3/4"	22 3/4"	16	1 1/4"	15 7/8"
20"	47"	22"	1 11/16"	27 1/2"	51"	45 3/4"	19 1/2"	25"	20	1 1/4"	20 1/2"
24"	56"	26"	1 7/8"	32"	55"	49 1/2"	21 1/4"	29 1/2"	20	1 3/8"	20 1/2"
30"	64"	30 1/2"	2 1/8"	38 3/4"	72 1/2"	60 3/4"	27"	36"	28	1 3/8"	31"
36"	70 1/2"	35"	2 3/8"	46"	77"	64"	28 1/2"	42 3/4"	32	1 5/8"	31"
42"	83 1/4"	43"	2 5/8"	53"	94"	79"	36"	49 1/2"	36	1 5/8"	37 3/4"
48"	93"	47 1/2"	2 3/4"	59 1/2"	98 1/2"	82 1/2"	40 1/2"	56"	44	1 5/8"	37 3/4"
54"	101"	54"	3"	66 1/4"	105"	85 1/2"	47 1/2"	62 3/4"	44	1 7/8"	50"
60"	111"	61"	3 1/8"	73"	112"	88 1/2"	51 1/2"	69 1/4"	52	1 7/8"	50"

	STANDARD 125 LBS. OPERATING PRESSURE								250 LBS. OPERATING PRESSURE					
Valve Size	X	X^1	X^2	Y	Y^1	Y^2	Z	Z^1	A	C	D	H	I	J
6"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	24"	1 7/16"	12 1/2"	10 5/8"	12	7/8"
8"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	24 1/2"	1 5/8"	15"	13"	12	1"
10"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	29 1/2"	1 7/8"	17 1/2"	15 1/4"	16	1 1/8"
12"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	32 1/2"	2"	20 1/2"	17 3/4"	16	1 1/4"
14"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	37"	2 1/8"	23"	20 1/4"	20	1 1/4"
16"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	41"	2 1/4"	25 1/2"	22 1/2"	20	1 3/8"
18"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	43 3/8"	2 3/8"	28"	24 3/4"	24	1 3/8"
20"	20"	2"	8"	31 1/2"	1 3/4"	14"	1 3/4"	1 3/4"	48 5/8"	2 1/2"	30 1/2"	27"	24	1 3/8"
24"	20"	2"	8"	31 1/2"	1 3/4"	14"	1 3/4"	1 3/4"	57 3/4"	2 3/4"	36"	32"	24	1 5/8"
30"	30"	5"	10"	30"	2 1/2"	12 1/2"	1 1/2	2 1/4"	65 3/4"	3"	43"	39 1/4"	28	1 7/8"
36"	35 1/2"	4 1/4"	13 1/2"	36"	3"	15"	1 1/2"	2 1/4"	74"	3 3/8"	50"	46"	32	2 1/4"
42"	42"	5 1/2"	15 1/2"	42"	4"	17"	2 1/4"	2 5/8"	85 3/8"	3 11/16"	57"	52 3/4"	36	2 1/4"
48"	54"	6"	21"	54"	6"	21"	2 1/2"	2 5/8"	95 1/2"	4"	65"	60 3/4"	40	2 1/4"
54"	54"	6"	21"	54"	6"	21"	2 3/4"	2 3/4"			SPECIAL			
60"	60"	9"	21"	60"	9"	21"	2 3/4"	3"			SPECIAL			



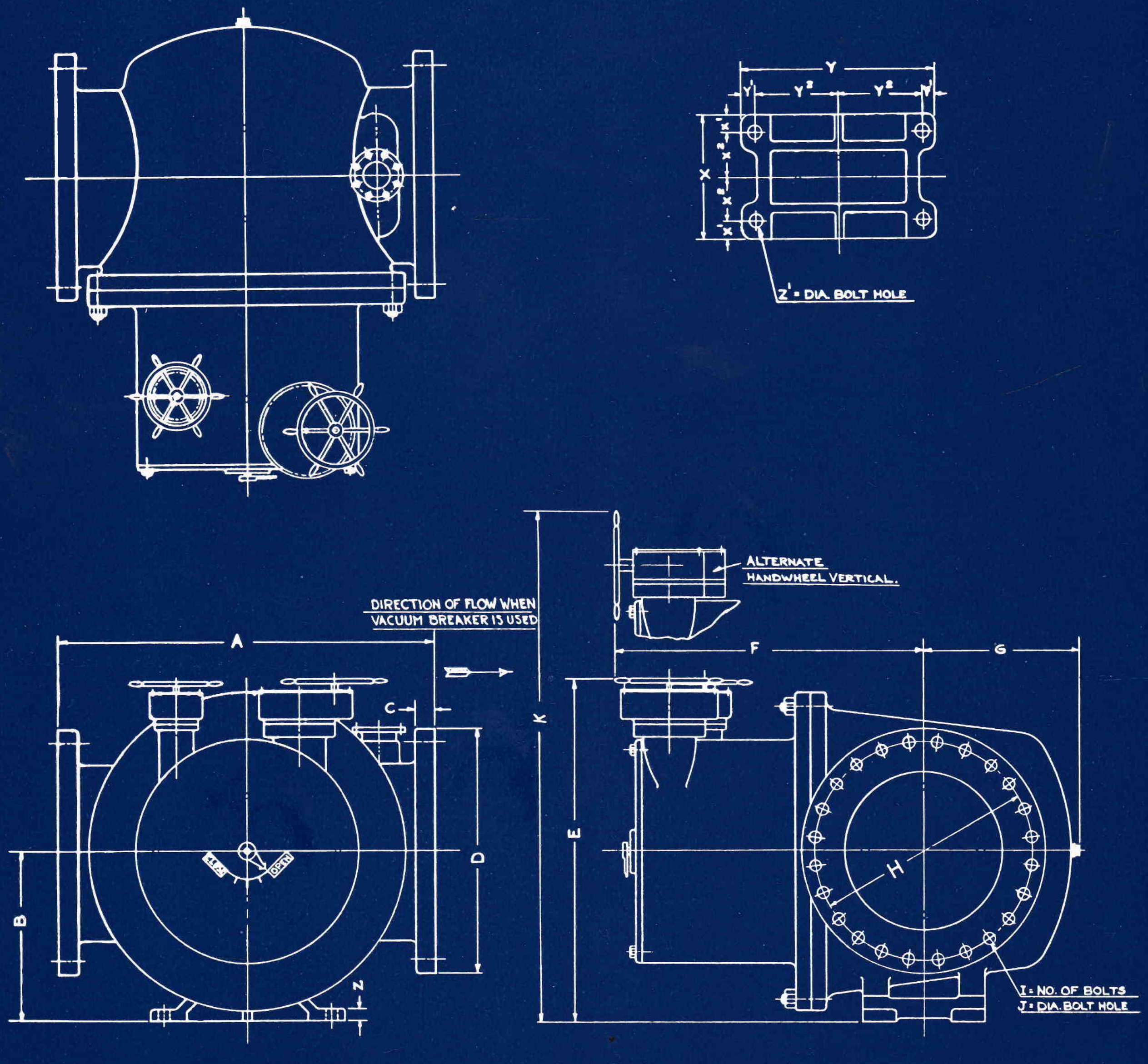
OUTLINE DRAWING OF
STANDARD MANUAL ROTOVALVE, SINGLE OPERATING STEM.

STANDARD 125 LBS. OPERATING PRESSURE

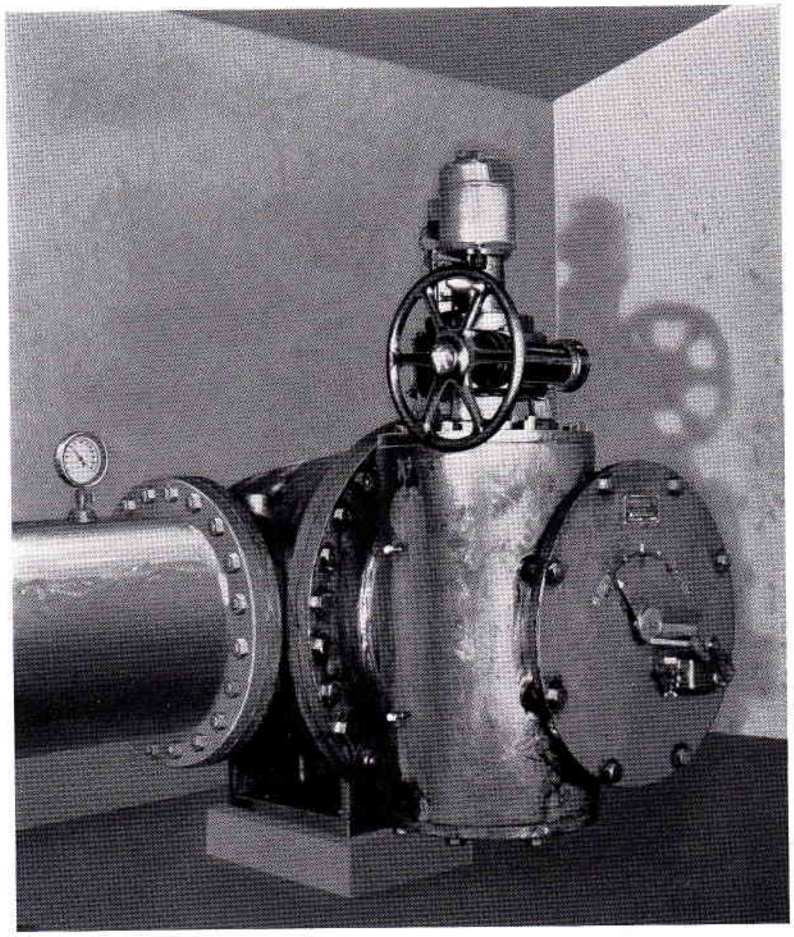
Valve Size	A	B	C	D	E	F	G	H	I	J	K	X	X^1	X^2	Y	Y^1	Y^2	Z	Z^1
6"	23 1/8"	9 1/2"	1"	11"	23 1/4"	28 3/4"	7 1/2"	9 1/2"	8	7/8"		8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"
8"	23 1/2"	9 1/2"	1 1/8"	13 1/2"	23 1/4"	28 3/4"	8 3/4"	11 3/4"	8	7/8"		8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"
10"	28 1/8"	12"	1 3/16"	16"	25 3/4"	30 1/4"	11 1/2"	13 1/4"	12	1"		8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"
12"	31"	14"	1 1/4"	19"	34 1/8"	33 3/8"	12 1/2"	17"	12	1"		14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"
14"	35 1/2"	15 1/2"	1 3/8"	21"	35 5/8"	34 3/8"	13 1/4"	18 3/4"	12	1 1/4"		14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"
16"	39"	17 1/8"	1 7/16"	23 1/2"	40 3/4"	39 1/4"	15 1/2"	21 1/4"	16	1 1/8"		14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"
18"	41 3/4"	19 1/4"	1 9/16"	25"	42 7/8"	40 1/4"	17 3/4"	22 3/4"	16	1 1/4"		14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"
20"	47"	22"	1 11/16"	27 1/2"	54 7/8"	48 3/4"	19 1/2"	25"	20	1 1/4"	57 3/8"	20"	2"	8"	31 1/2"	1 3/4"	14"	1 3/4"	1 3/4"
24"	56"	26"	1 7/8"	32"	58 7/8"	50 3/4"	21 1/4"	29 1/2"	20	1 3/8"	61 3/8"	20"	2"	8"	31 1/2"	1 3/4"	14"	1 3/4"	1 3/4"
30"	64"	30 1/2"	2 1/8"	38 3/4"	77 7/8"	67 3/4"	27"	36"	28	1 3/8"	77 3/8"	30"	5"	10"	30"	2 1/2"	12 1/2"	1 1/2"	2 1/4"
36"	70 1/2"	35"	2 3/8"	46"	82 3/8"	71"	28 1/2"	42 3/4"	32	1 5/8"	81 7/8"	35 1/2"	4 1/4"	13 1/2"	36"	3"	15"	1 1/2"	2 1/4"
42"	83 1/4"	43"	2 5/8"	53"	112 1/2"	79 3/4"	36"	49 1/2"	36	1 5/8"	109 1/4"	42"	5 1/2"	15 1/2"	42"	4"	17"	2 1/4"	2 5/8"
48"	93"	47 1/2"	2 3/4"	59 1/2"	117"	83 1/4"	40 1/2"	56"	44	1 5/8"	113 3/4"	54"	6"	21"	54"	6"	21"	2 1/2"	2 5/8"
54"	101"	54"	3"	66 1/4"	123"	90 5/8"	47 1/2"	62 3/4"	44	1 7/8"	121 1/4"	54"	6"	21"	54"	6"	21"	2 3/4"	2 3/4"
60"	111"	61"	3 1/8"	73"	130"	93 5/8"	51 1/2"	69 1/4"	52	1 7/8	128 1/4"	60"	9"	21"	60"	9"	21"	2 3/4"	3"

250 LBS. OPERATING PRESSURE

Valve Size	A	C	D	H	I	J
6"	24"	1 7/16"	12 1/2"	10 5/8"	12	7/8"
8"	24 1/2"	1 5/8"	15"	13"	12	1"
10"	29 1/2"	1 7/8"	17 1/2"	15 1/4"	16	1 1/8"
12"	32 1/2"	2"	20 1/2"	17 3/4"	16	1 1/4"
14"	37"	2 1/8"	23"	20 1/4"	20	1 1/4"
16"	41"	2 1/4"	25 1/2"	22 1/2"	20	1 3/8"
18"	43 3/8"	2 3/8"	28"	24 3/4"	24	1 3/8"
20"	48 5/8"	2 1/2"	30 1/2"	27"	24	1 3/8"
24"	57 3/4"	2 3/4"	36"	32"	24	1 5/8"
30"	65 3/4"	3"	43"	39 1/4"	28	1 7/8"
36"	74"	3 3/8"	50"	46"	32	2 1/4"
42"	85 3/8"	3 11/16"	57"	52 3/4"	36	2 1/4"
48"	95 1/2"	4"	65"	60 3/4"	40	2 1/4"
54"			SPECIAL			
60"			SPECIAL			



OUTLINE DRAWING OF STANDARD MANUAL RESEATING ROTOVALVE, HORIZONTAL MOUNTING.



Installation of a standard motor operated ROTOVALVE, City of Denver, Colorado.

Motor Operated Valves

MANUAL ROTOVALVES of either the single or dual stem type can be easily adapted to motor operation.

All information relative to the intended operation, together with the characteristics of the electric current available, must be furnished prior to purchase.

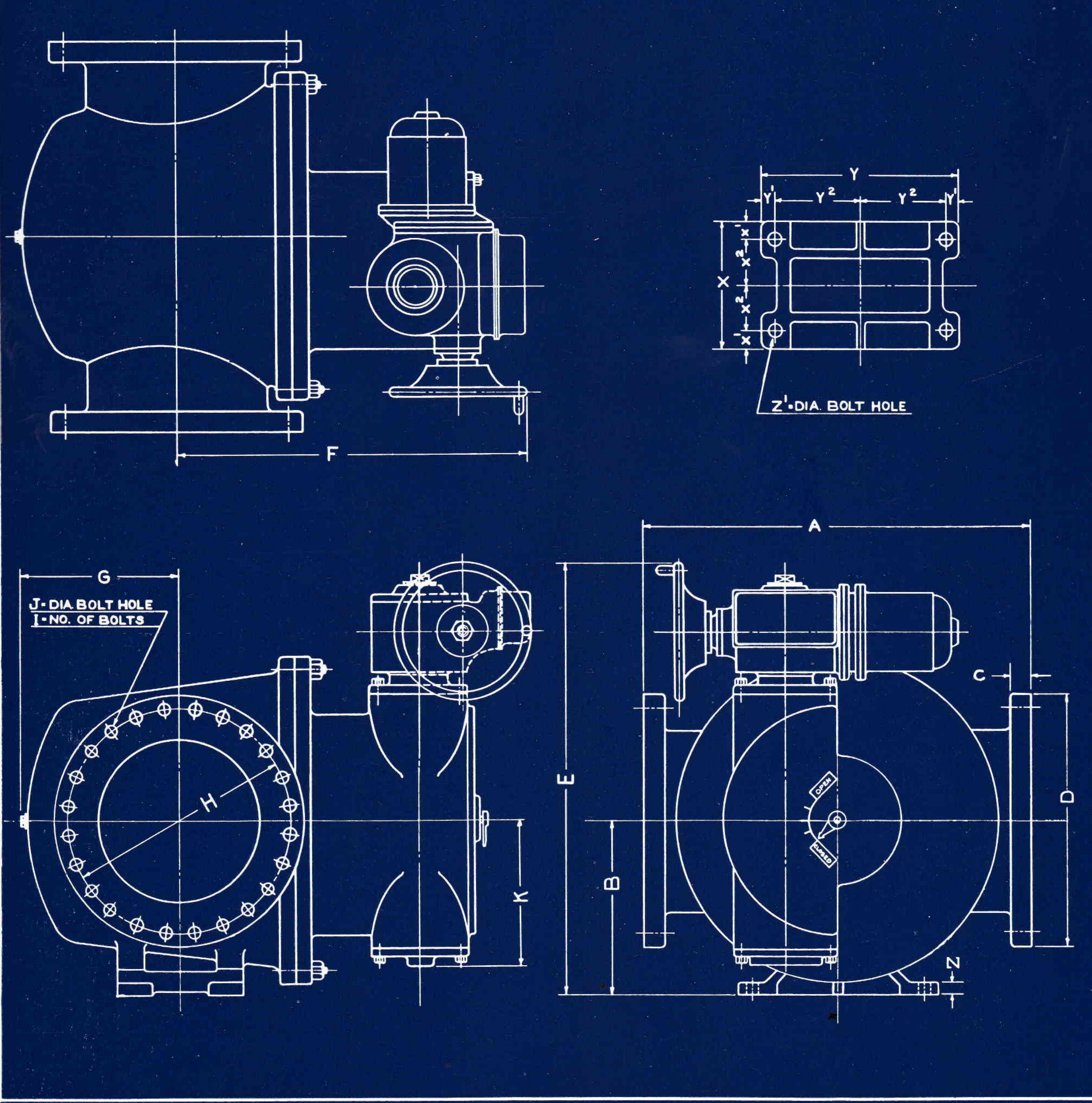
Due to the wide variation of operating conditions, it is impossible to establish any arrangement or group of arrangements of motors applying to ROTOVALVES without confusing the subject. Therefore, the dimensions on the outline drawings on pages 59 and 60 referring to the motor and its controls are only approximate. All other dimensions may be considered correct.

Motors and controls, push-button stations, float switches, and related appurtenances can be furnished for all types of services and for all variations of electrical characteristics, thus permitting a wide selection.

Motor operation is particularly adaptable where it is desired to open, close or throttle a valve or battery of valves from either an immediate or a remote location.

All motor operated units are equipped with auxiliary manual means for emergency operation in the event of power or motor failure.

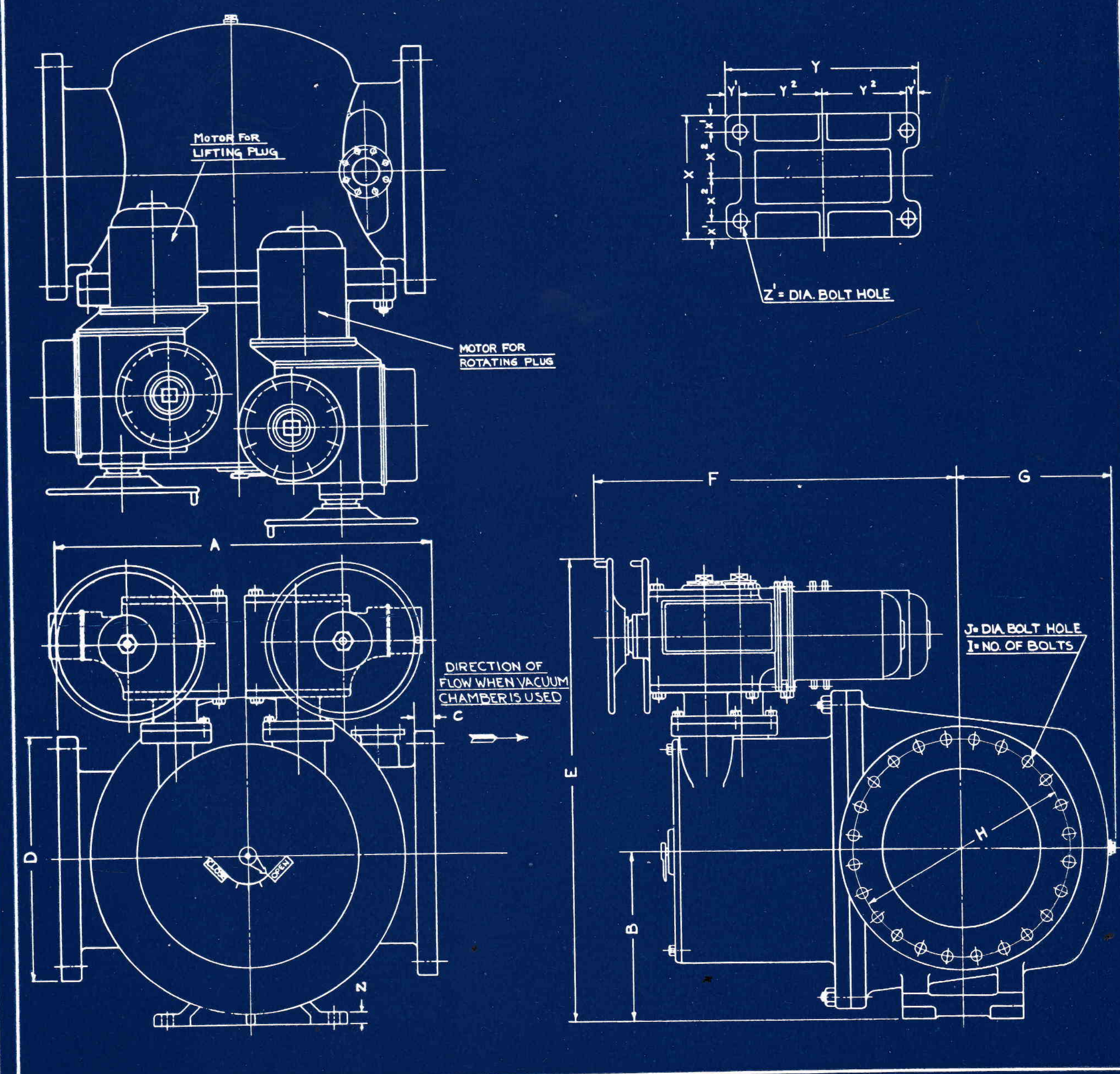
Valve Size	STANDARD 125 LBS. OPERATING PRESSURE																			250 LBS. OPERATING PRESSURE					
	A	B	C	D	E	F	G	H	I	J	K	X	X¹	X²	Y	Y¹	Y²	Z	Z¹	A	C	D	H	I	J
6"	23 1/8"	9 1/2"	1"	11"	32"	25"	7 1/2"	9 1/2"	8	7/8"	11 3/8"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	24"	1 7/16"	12 1/2"	10 5/8"	12	7/8"
8"	23 1/2"	9 1/2"	1 1/8"	13 1/2"	32"	25"	8 3/4"	11 3/4"	8	7/8"	11 3/8"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	24 1/2"	1 5/8"	15"	13"	12	1"
10"	28 1/8"	12"	1 3/16"	16"	34 1/2"	26 1/2"	11 1/2"	14 1/4"	12	1"	11 3/8"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	29 1/2"	1 7/8"	17 1/2"	15 1/4"	16	1 1/8"
12"	31"	14"	1 1/4"	19"	43 1/2"	36"	12 1/2"	17"	12	1"	12 7/8"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	32 1/2"	2"	20 1/2"	17 3/4"	16	1 1/4"
14"	35 1/2"	15 1/2"	1 3/8"	21"	45"	37"	13 1/4"	18 3/4"	12	1 1/8"	12 7/8"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	37"	2 1/8"	23"	20 1/4"	20	1 1/4"
16"	39"	17 1/8"	1 7/16"	23 1/2"	49 3/8"	40"	15 1/2"	21 1/4"	16	1 1/8"	15 7/8"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	41"	2 1/4"	25 1/2"	22 1/2"	20	1 3/8"
18"	41 3/4"	19 1/4"	1 9/16"	25"	51 1/2"	41"	17 3/4"	22 3/4"	16	1 1/4"	15 7/8"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	43 3/8"	2 3/8"	28"	24 3/4"	24	1 3/8"
20"	47"	22"	1 11/16"	27 1/2"	57 3/4"	45 1/4"	19 1/2"	25"	20	1 1/4"	20 1/2"	20"	2"	8"	31 1/2"	1 3/4"	14"	1 3/4"	1 3/4"	48 5/8"	2 1/2"	30 1/2"	27"	24	1 3/8"
24"	56"	26"	1 7/8"	32"	61 3/4"	49"	21 1/4"	29 1/2"	20	1 3/8"	20 1/2"	20"	2"	8"	31 1/2"	1 3/4"	14"	1 3/4"	1 3/4"	57 3/4"	2 3/4"	36"	32"	24	1 5/8"
30"	64"	30 1/2"	2 1/8"	38 3/4"	77 1/4"	57 1/4"	27"	36"	28	1 3/8"	31"	30"	5"	10"	30"	2 1/2"	12 1/2"	1 1/2"	2 1/4"	65 3/4"	3"	43"	39 1/4"	28	1 7/8"
36"	70 1/2"	35"	2 3/8"	46"	81 3/4"	60 1/2"	28 1/2"	42 3/4"	32	1 5/8"	31"	35 1/2"	4 1/4"	13 1/2"	36"	3"	15"	1 1/2"	2 1/4"	74"	3 3/8"	50"	46"	32	2 1/4"
42"	83 1/4"	43"	2 5/8"	53"	98 1/2"	72 1/4"	36"	49 1/2"	36	1 5/8"	37 3/4"	42"	5 1/2"	15 1/2"	42"	4"	17"	2 1/4"	2 5/8"	85 3/8"	3 11/16"	57"	52 3/4"	36	2 1/4"
48"	93"	47 1/2"	2 3/4"	59 1/2"	103"	75 3/4"	40 1/2"	56"	44	1 5/8"	37 3/4"	54"	6"	21"	54"	6"	21"	2 1/2"	2 5/8"	95 1/2"	4"	65"	60 3/4"	40	2 1/4"
54"	101"	54"	3"	66 1/4"	120"	88 3/4"	47 1/2"	62 3/4"	44	1 7/8"	50"	54"	6"	21"	54"	6"	21"	2 3/4"	2 3/4"			SPECIAL			
60"	111"	61"	3 1/8"	73"	127"	91 3/4"	51 1/2"	69 1/4"	52	1 7/8"	50"	60"	9"	21"	60"	9"	21"	2 3/4"	3"			SPECIAL			



OUTLINE DRAWING OF STANDARD
MOTOR OPERATED ROTOVALVE, SINGLE OPERATING STEM.

STANDARD 125 LBS. OPERATING PRESSURE											
Valve Size	A	B	C	D	E	F	G	H	I	J	K
6"	23 1/8"	9 1/2"	1"	11"	32"	25"	7 1/2"	9 1/2"	8	7/8"	
8"	23 1/2"	9 1/2"	1 1/8"	13 1/2"	32"	25"	8 3/4"	11 3/4"	8	7/8"	
10"	28 1/8"	12"	1 3/16"	16"	34 1/2"	26 1/2"	11 1/2"	14 1/4"	12	1"	
12"	31"	14"	1 1/4"	19"	45 11/16	38 3/8"	12 1/2"	17"	12	1"	
14"	35 1/2"	15 1/2"	1 3/8"	21"	47 3/16"	39 3/8"	13 1/4"	18 3/4"	12	1 1/8"	
16"	39"	17 1/8"	1 7/16"	23 1/2"	49 3/8"	40"	15 1/2"	21 1/4"	16	1 1/8"	
18"	41 3/4"	19 1/4"	1 9/16"	25"	51 1/2"	41"	17 3/4"	22 3/4"	16	1 1/4"	
20"	47"	22"	1 11/16"	27 1/2"	58 1/4"	49 1/8"	19 1/2"	25"	20	1 1/4"	
24"	56"	26"	1 7/8"	32"	62 1/4"	52 7/8"	21 1/4"	29 1/2"	20	1 3/8"	
30"	64"	30 1/2"	2 1/8"	38 3/4"	75"	67"	27"	36"	28	1 3/8"	
36"	70 1/2"	35"	2 3/8"	46"	79 1/2"	70 1/4"	28 1/2"	42 3/4"	32	1 5/8"	
42"	83 1/4"	43"	2 5/8"	53"	98 1/2"	82 1/4"	36"	49 1/2"	36	1 5/8"	
48"	93"	47 1/2"	2 3/4"	59 1/2"	103"	85 3/4"	40 1/2"	56"	44	1 5/8"	
54"	101"	54"	3"	66 1/4"	120"	98 3/4"	47 1/2"	62 3/4"	44	1 7/8"	
60"	111"	61"	3 1/8"	73"	127"	101 3/4"	51 1/2"	69 1/4"	52	1 7/8"	

Valve Size	X	X^1	X^2	Y	Y^1	Y^2	Z	Z^1	250 LBS. OPERATING PRESSURE A	C	D	H	I	J
6"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	24"	1 7/16"	12 1/2"	10 5/8"	12	7/8"
8"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	24 1/2"	1 5/8"	15"	13"	12	1"
10"	8 1/2"	1 1/4"	3"	14 1/2"	1 1/4"	6"	1"	1 1/4"	29 1/2"	1 7/8"	17 1/2"	15 1/4"	16	1 1/8"
12"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	32 1/2"	2"	20 1/2"	17 3/4"	16	1 1/4"
14"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	37"	2 1/8"	23"	20 1/4"	20	1 1/4"
16"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	41"	2 1/4"	25 1/2"	22 1/2"	20	1 3/8"
18"	14"	2"	5"	22"	1 1/2"	9 1/2"	1 1/2"	1 3/8"	43 3/8"	2 3/8"	28"	24 3/4"	24	1 3/8"
20"	20"	2"	8"	31 1/2"	1 3/4"	14"	1 3/4"	1 3/4"	48 5/8"	2 1/2"	30 1/2"	27"	24	1 3/8"
24"	20"	2"	8"	31 1/2"	1 3/4"	14"	1 3/4"	1 3/4"	57 3/4"	2 3/4"	36"	32"	24	1 5/8"
30"	30"	5"	10"	30"	2 1/2"	12 1/2"	1 1/2	2 1/4"	65 3/4"	3"	43"	39 1/4"	28	1 7/8"
36"	35 1/2"	4 1/4"	13 1/2"	36"	3"	15"	1 1/2"	2 1/4"	74"	3 3/8"	50"	46"	32	2 1/4"
42"	42"	5 1/2"	15 1/2"	42"	4"	17"	2 1/4"	2 5/8"	85 3/8"	3 11/16"	57"	52 3/4"	36	2 1/4"
48"	54"	6"	21"	54"	6"	21"	2 1/2"	2 5/8"	95 1/2"	4"	65"	60 3/4"	40	2 1/4"
54"	54"	6"	21"	54"	6"	21"	2 3/4"	2 3/4"			SPECIAL			
60"	60"	9"	21"	60"	9"	21"	2 3/4"	3"			SPECIAL			



OUTLINE DRAWING OF STANDARD
MOTOR OPERATED RESEATING VALVE, DUAL OPERATING STEMS.

MOTOR OPERATORS

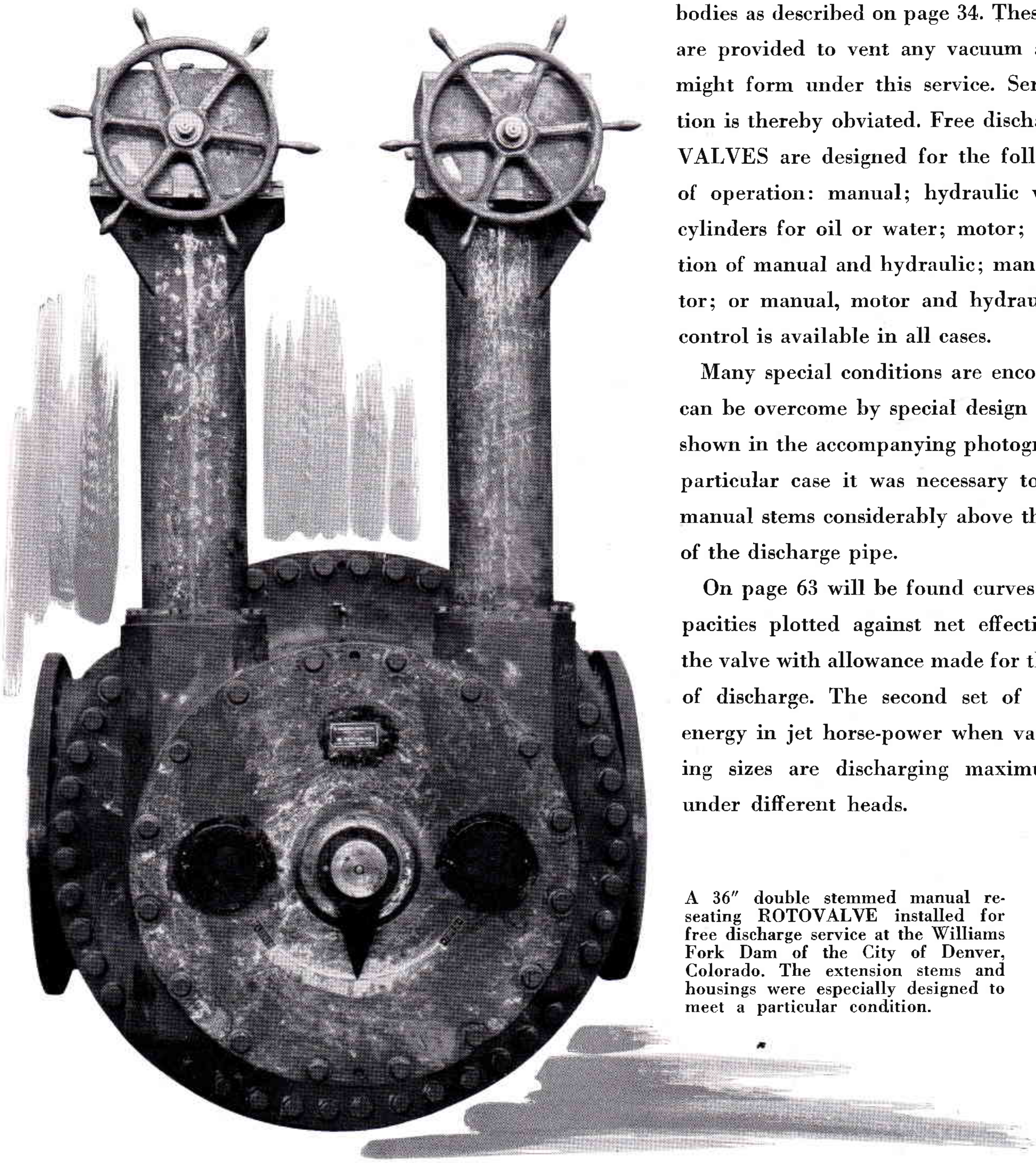
THE outline dimension drawings, found on pages 59 and 60, show an average size of motor operator for each size of valve.

The motor operator accomplishes two things: first, it lifts the plug, and second, rotates it. The lifting effort is in direct proportion to the static head on the valves. The rotating effort is affected by the flow and the head. In single stem valves, the larger of these two forces determines the capacity of the motor. On dual stem valves the motor sizes may vary on the individual stems. Motor capacities are dependent not only upon the aforementioned factors but also upon time of operation.

In the case of reseating valves, the motor circuits should be interlocked so that it is impossible to rotate the plug until it has been raised and unseated, and also interlocked so that when the rotating movement is ended, the lifting motor will immediately reverse and reseat the valve. Position indicator lights can be furnished at an additional charge.

Photograph of a major break in a 36″ pipe line taken by the Rocky Mountain News, Denver, Colorado, April 18, 1935.

Free Discharge Valves



ROTOVALVES for free discharge service are of the reseating type.

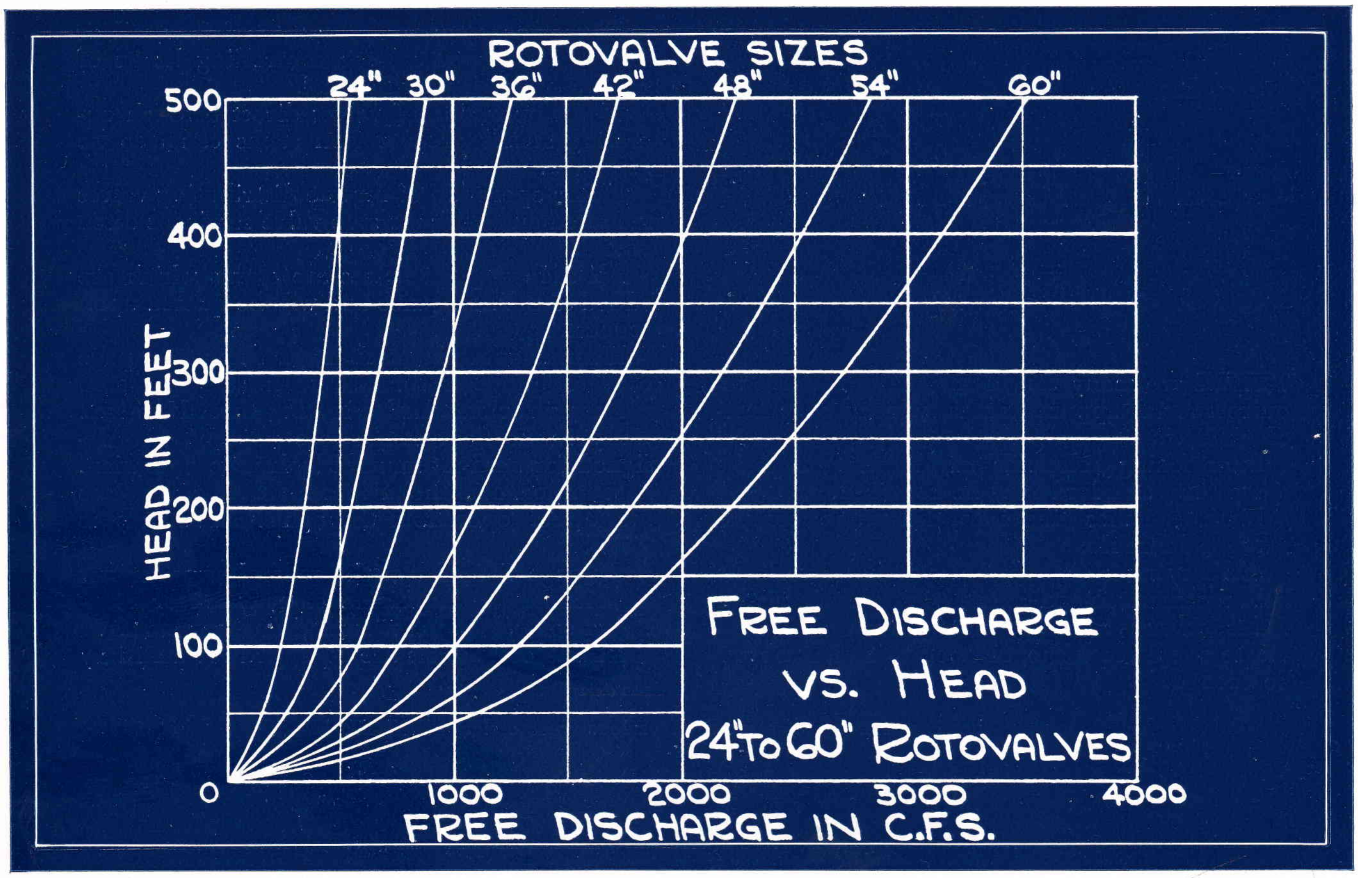
Pages 52 and 53 show the sectional assemblies, parts numbers and materials of this valve. Page 57 contains an outline dimension drawing.

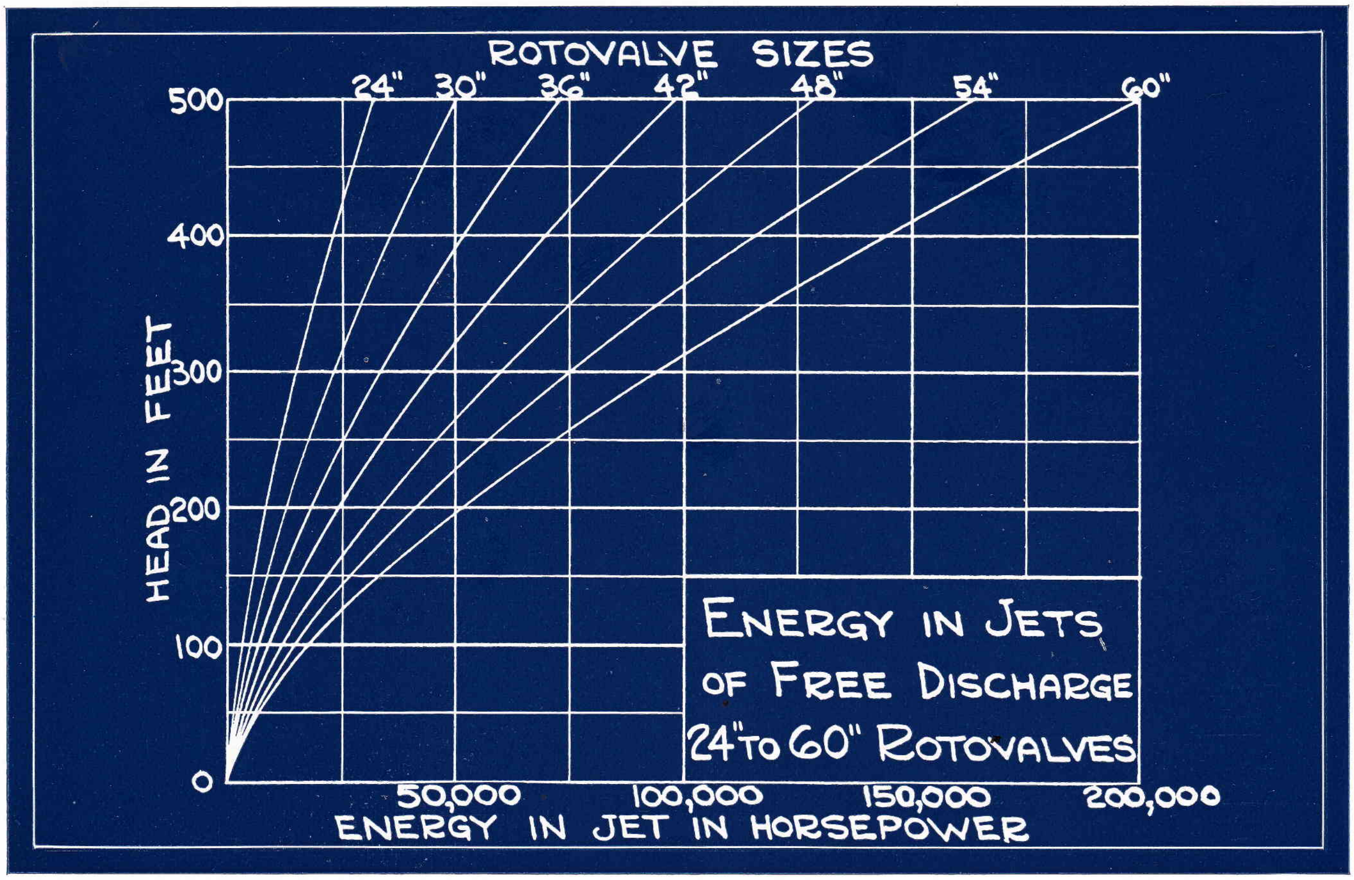
All ROTOVALVES designed for this particular service are equipped with manifolds integrally cast with the downstream section of the bodies as described on page 34. These manifolds are provided to vent any vacuum areas which might form under this service. Serious cavitation is thereby obviated. Free discharge ROTOVALVES are designed for the following types of operation: manual; hydraulic with double cylinders for oil or water; motor; or combination of manual and hydraulic; manual and motor; or manual, motor and hydraulic. Remote control is available in all cases.

Many special conditions are encountered and can be overcome by special design such as that shown in the accompanying photograph. In this particular case it was necessary to mount the manual stems considerably above the centerline of the discharge pipe.

On page 63 will be found curves of valve capacities plotted against net effective heads at the valve with allowance made for the coefficient of discharge. The second set of curves show energy in jet horse-power when valves of varying sizes are discharging maximum capacity under different heads.

A 36″ double stemmed manual reseating ROTOVALVE installed for free discharge service at the Williams Fork Dam of the City of Denver, Colorado. The extension stems and housings were especially designed to meet a particular condition.


ROTOVALVE SIZES
24" 30" 36" 42" 48" 54" 60"
500
400
300
200
100
0
HEAD IN FEET
1000
2000
3000
4000
FREE DISCHARGE IN C.F.S.
FREE DISCHARGE VS. HEAD 24" TO 60" ROTOVALVES


ROTOVALVE SIZES
24" 30" 36" 42" 48" 54" 60"
500
400
300
200
100
0
HEAD IN FEET
50,000
100,000
150,000
200,000
ENERGY IN JET IN HORSEPOWER
ENERGY IN JETS OF FREE DISCHARGE 24" TO 60" ROTOVALVES

Operating Stands and Miscellaneous Appurtenances

THERE are many varying conditions which require special appurtenances, worthy of particular mention.

Interlocking solenoids or diaphragm pilots other than standard may be required.

Limit switches tied into the pump control may be desirable.

Mercury switches, pressure switches, interlocks between manual and automatic controls, signal lights, sirens, various types of valve position indicators and recorders, or operation alarms may be needed.

Time clocks, controls for rate of flow, oil or mechanical governors for controlling limits of operating speed may be used.

Motor operation of valves direct through operating stands or extension stems can also be arranged.

Motor operation of remote distributing valves mounted on stands for stop valve service is often useful.

All such appurtenances are extras which are added to the base price and will be quoted upon request.

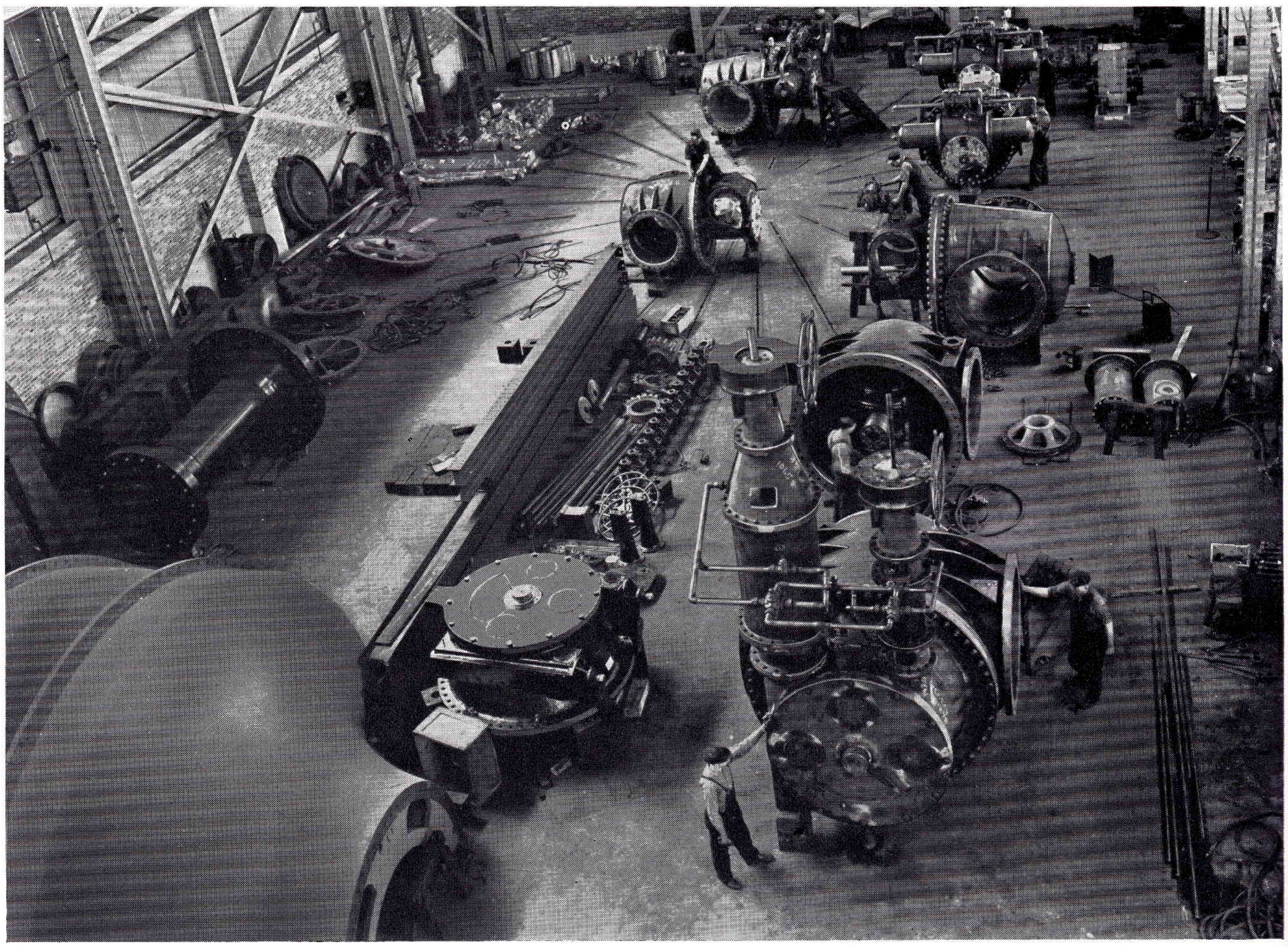
Manual operating stands, as shown on page 65, are designed for use with standard stop valves or for standard reseating throttle valves.

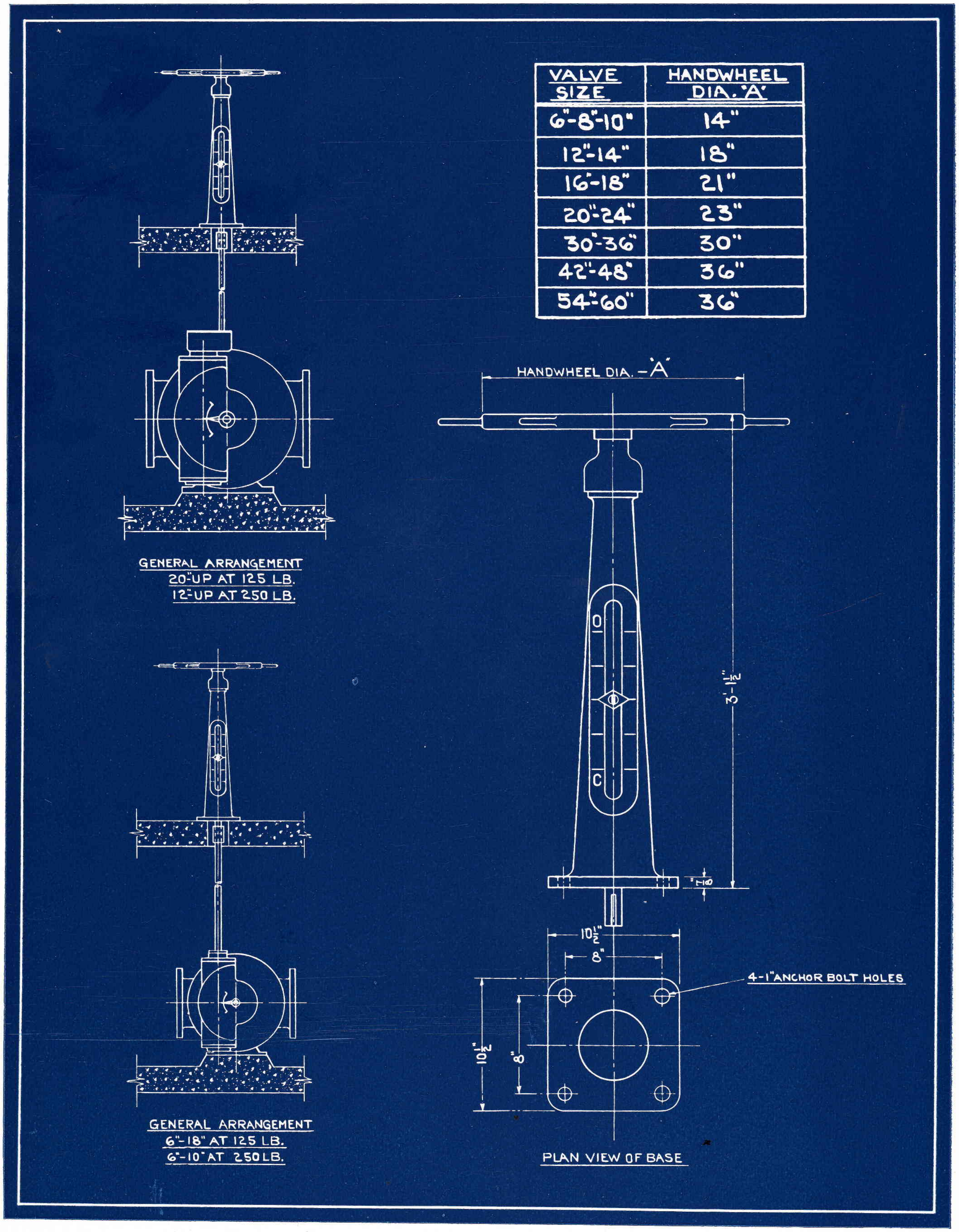
Hydraulic floor stands, see page 66, are designed for straight manual hydraulic operation. Also, on page 66 the proper mounting of motors for direct operation through floor stands is given.

On page 67 is shown the general arrangement of solenoid or diaphragm stop, check or regulating controls when mounted on floor stands.

All motor controls are equipped for auxiliary manual operation.

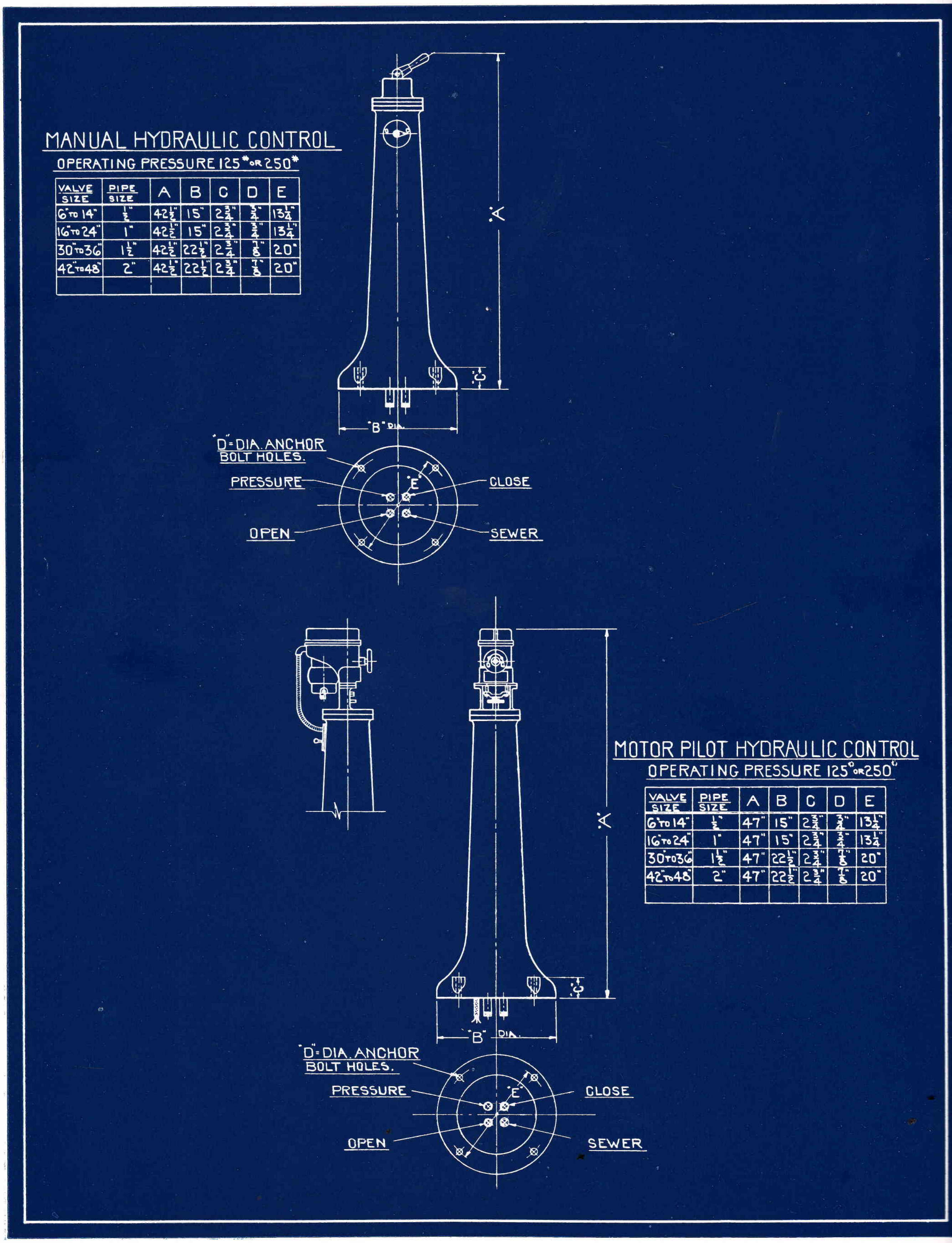
Shop view showing assembly of a group of various types of large ROTOVALVES.





VALVE SIZE	HANDWHEEL DIA. "A"
6"-8"-10"	14"
12"-14"	18"
16"-18"	21"
20"-24"	23"
30"-36"	30"
42"-48"	36"
54"-60"	36"

FLOOR STANDS FOR MANUAL OPERATION.



MANUAL HYDRAULIC CONTROL

OPERATING PRESSURE 125# OR 250#

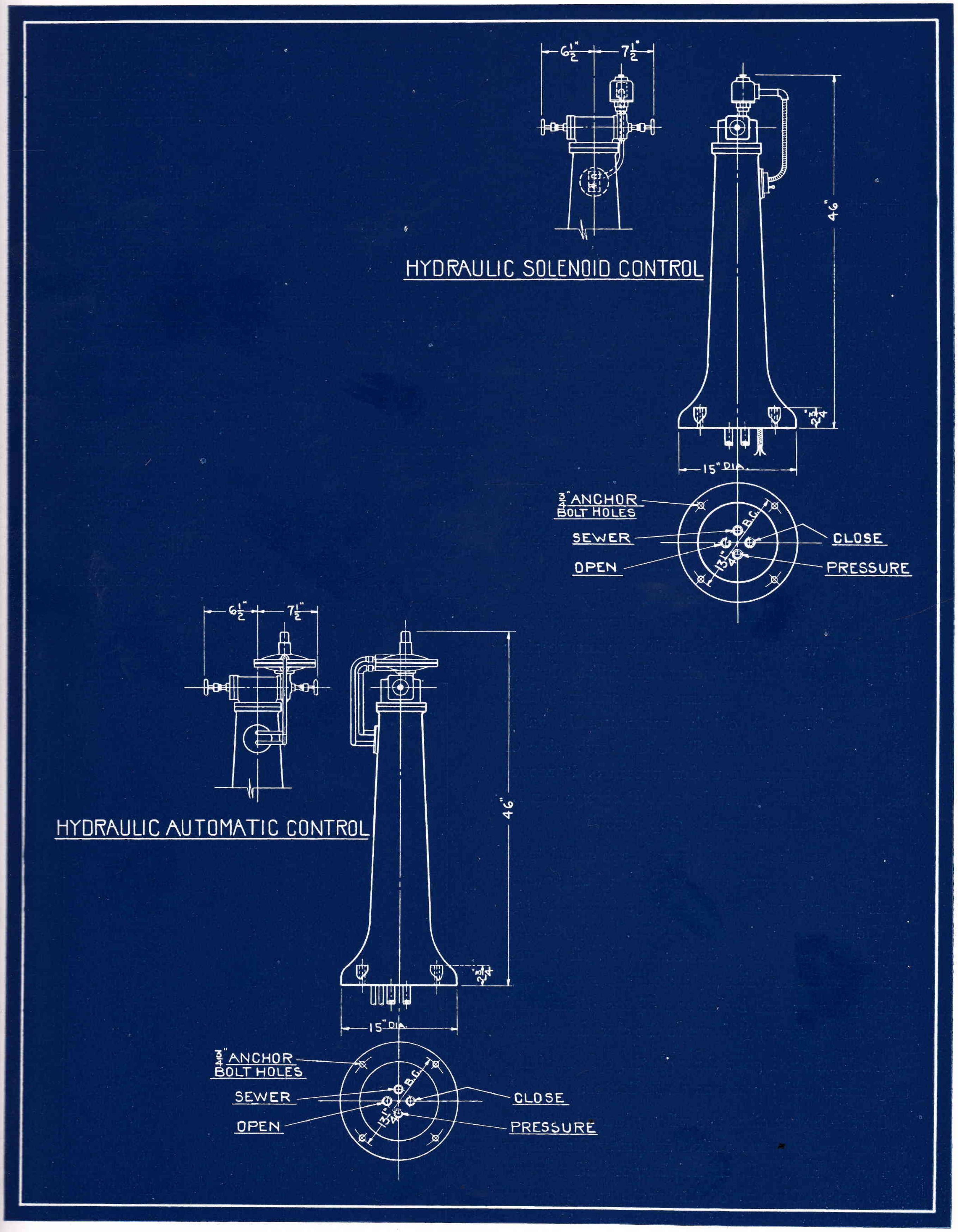
VALVE SIZE	PIPE SIZE	A	B	C	D	E
6" TO 14"	½"	42½"	15"	2¾"	¾"	13¼"
16" TO 24"	1"	42½"	15"	2¾"	¾"	13¼"
30" TO 36"	1½"	42½"	22½"	2¾"	⅞"	20"
42" TO 48"	2"	42½"	22½"	2¾"	⅞"	20"

MOTOR PILOT HYDRAULIC CONTROL

OPERATING PRESSURE 125# OR 250#

VALVE SIZE	PIPE SIZE	A	B	C	D	E
6" TO 14"	½"	47"	15"	2¾"	¾"	13¼"
16" TO 24"	1"	47"	15"	2¾"	¾"	13¼"
30" TO 36"	1½"	47"	22½"	2¾"	⅞"	20"
42" TO 48"	2"	47"	22½"	2¾"	⅞"	20"

FLOOR STANDS FOR MANUAL HYDRAULIC, AND MOTOR OPERATION.



FLOOR STANDS FOR AUTOMATIC HYDRAULIC, SOLENOID AND DIAPHRAGM OPERATION.

Surge *Relief* VALVES

SURGE relief valves of the Angle Needle type are used for the dissipation of surges in any pressure line. They are actuated by pressure in excess of an adjustable predetermined setting.

The opening stroke is almost instantaneous but the closing stroke is slow and may be regulated to suit the particular conditions of each installation. These valves are available in the standard sizes shown on pages 69 and 70. Outline dimensions, parts numbers, and material specifications will also be found thereon. The valves are divided into two groups. The sizes six inches and smaller operate directly from a pilot valve. Those eight inches and larger operate by a pilot through a relay valve.

All valve operations are initiated by pressure in the line acting upon a pilot plunger which is loaded by weight. When the line pressure rises to the predetermined point, the pilot plunger moves upward and assumes a position which will vent the top of the main needle valve plunger to atmosphere. Since the lower side of the main plunger is under pressure, it moves rapidly upward. Its stroke and discharge can be limited by an adjustable stop screw.

As soon as the line pressure drops sufficiently, both pilot plunger and weight again assume their normal positions. Drainage from the top of the main valve plunger is thus stopped. An adjustable regulating device in the pilot pressure line admits water to the chamber above the main plunger and by reason of the differential areas slowly forces it down to the closed position.

A tell-tale rod goes through the center of the stop screw and is used as an indicator.

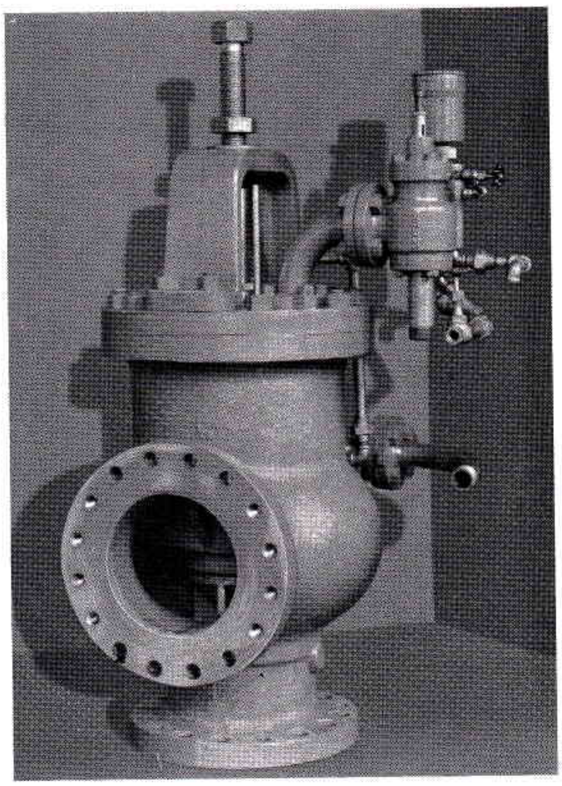
On the larger sizes the pilot plunger actuates a small relay valve which instantly discharges the water above the main plunger and permits it to open. Closure of the main valve occurs when the pressure in the line drops sufficiently to permit the pilot plunger and weight to fall. The relay valve then closes rapidly but the main valve closes slowly. Its closing time is adjustable by means of a small needle valve which limits the flow of water to the chamber above the main plunger.

In general, it is recommended that lines with *variable* flow be provided with batteries of relay valves as shown in the installation drawing on page 71. Valves in such batteries are set to operate at successively higher pressures. Hence only the proper number will open which are necessary to compensate for the amount of flow which is shut off. By this method an excess discharge area, which under the particular flow condition might exist with a single large relief valve, is not employed. A resulting undesirable pressure drop and increased flow are thus largely avoided.

Lines under *constant* flow may be provided with but one or two relief valves. Installation drawings appear on pages 29 and 39.

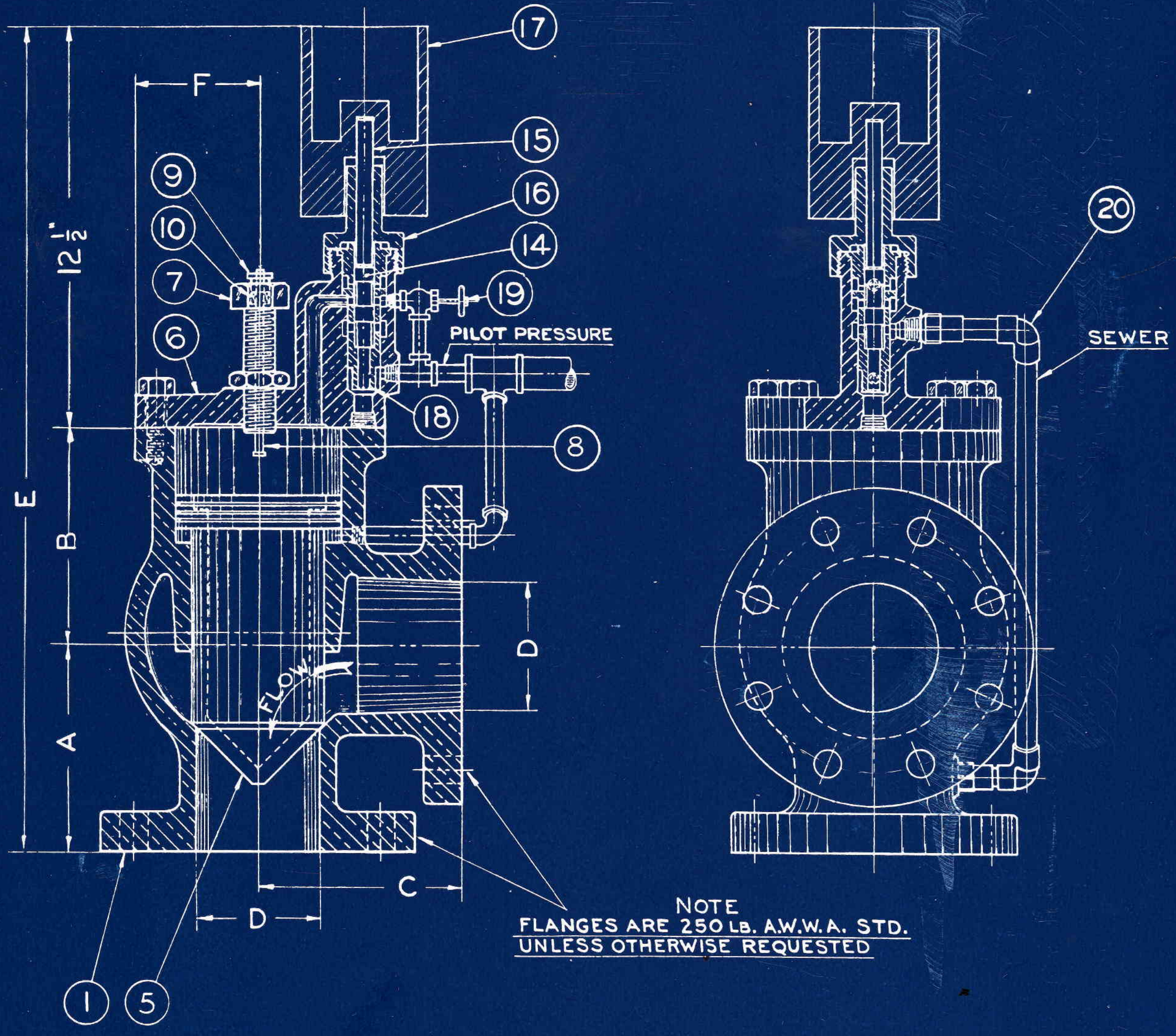
Areas and capacities of Angle Needle Relief Valves are given on page 72.

8″ Angle Needle Relief Valve.



No.	Part Name	Material	Specification
1	Body	Bronze	ASTM B60-36
5	Plunger	Bronze	ASTM B60-36
6	Cover & Pilot Valve Body	Bronze	ASTM B60-36
7	Adjusting Screw	Bronze	
8	Indicator Stem	Bronze	
9	Packing Gland	Bronze	
10	Packing	Fibre	Braided
14	Pilot Plunger	Monel	
15	Pilot Stem	Bronze	
16	Guide	Bronze	
17	Weight	Cast Iron	
18	Sleeve	Bronze	
19	Timing Valve	Bronze	
20	Sewer Pipe	Copper	

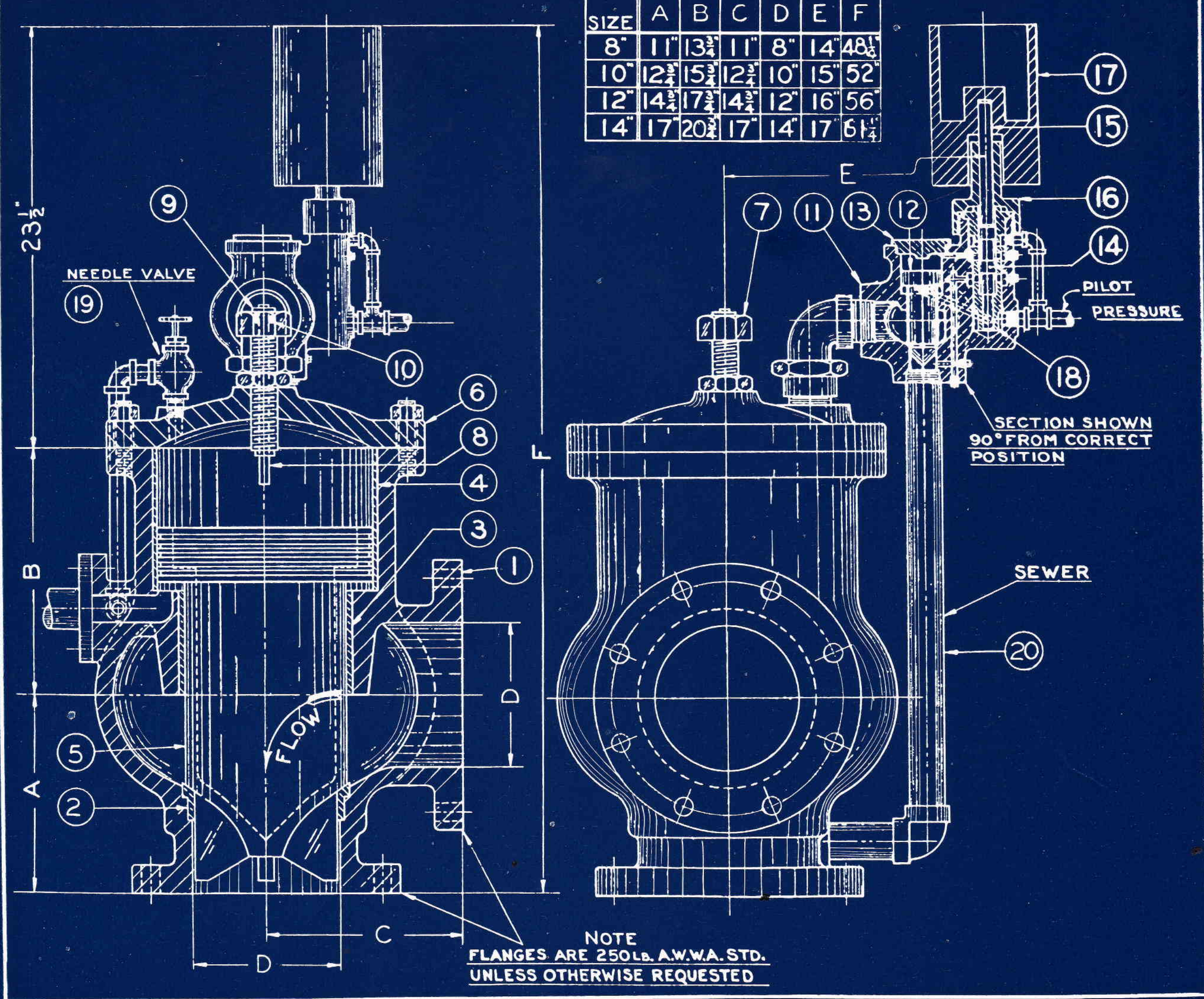
SIZE	A	B	C	D	E	F
4"	6½"	6¾"	6½"	4"	25¾"	4"
5"	7¾"	8"	7¾"	5"	27¾"	4⅝"
6"	8"	9¼"	8"	6"	29¾"	5¼"



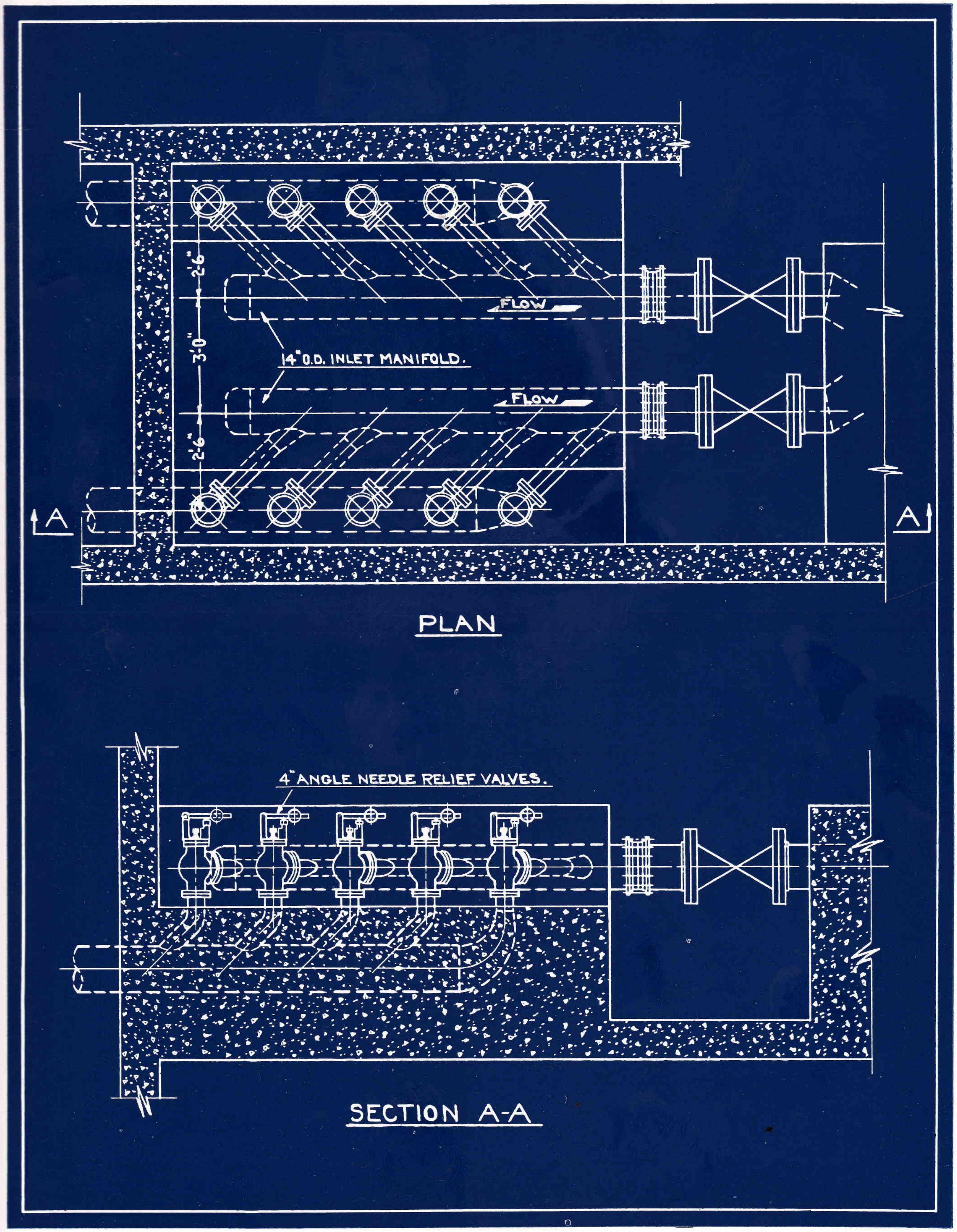
STANDARD ANGLE NEEDLE RELIEF VALVES, 4″ to 6″.

		125 LB. STANDARD		250 LB. STANDARD	
No.	Part Name	Material	Specification	Material	Specification
1	Body	Cast Iron	ASTM A48-36 No. 40	Cast Steel	ASTM A27-36T Grade "B"
2	Seat	Bronze	ASTM B60-36	Bronze	ASTM B60-36
3	Bushing	Bronze	ASTM B60-36	Bronze	ASTM B60-36
4	Cylinder Liner	Bronze	ASTM B74-32T	Bronze	ASTM B74-32T
5	Plunger	Bronze	ASTM B60-36	Bronze	ASTM B60-36
6	Cover	Cast Iron	ASTM A48-36 No. 40	Cast Steel	ASTM A27-36T Grade "B"
7	Adjusting Screw	Bronze		Bronze	
8	Indicator Stem	Bronze		Bronze	
9	Packing Gland	Bronze		Bronze	
10	Packing	Fibre		Fibre	
11	Dump & Pilot Valve Body	Bronze	ASTM B60-36	Bronze	ASTM B60-36
12	Dump Valve Plunger	Bronze	Rolled Bronze	Bronze	Rolled Bronze
13	Cap	Bronze	ASTM B60-36	Bronze	ASTM B60-36
14	Pilot Plunger	Monel		Monel	
15	Pilot Stem	Bronze		Bronze	
16	Guide	Bronze		Bronze	
17	Weight	Cast Iron		Cast Iron	
18	Sleeve	Bronze		Bronze	
19	Timing Valve				
20	Sewer Pipe	Copper		Copper	

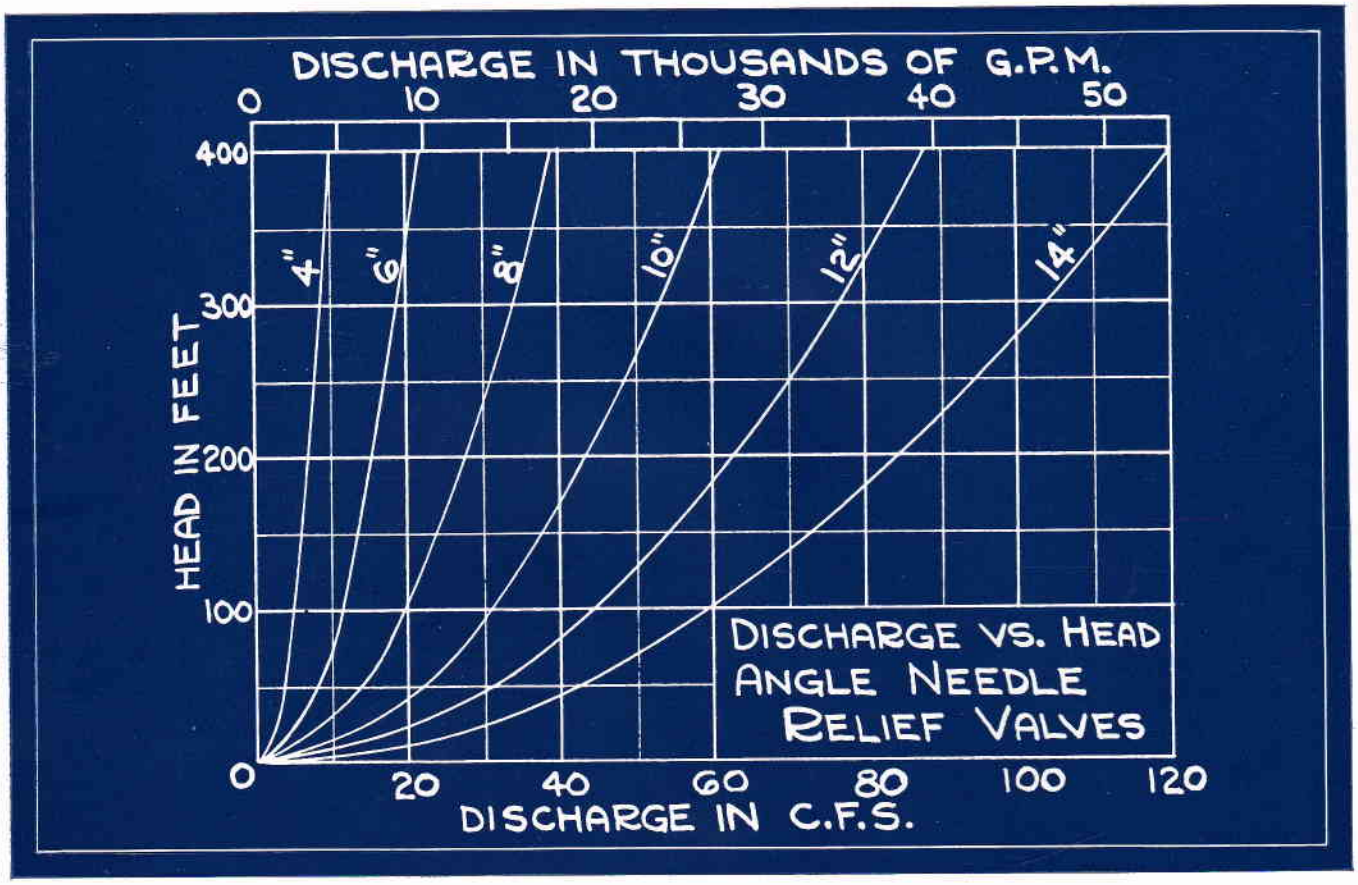
SIZE	A	B	C	D	E	F
8"	11"	13¾"	11"	8"	14"	48⅛"
10"	12¾"	15¾"	12¾"	10"	15"	52"
12"	14¾"	17¾"	14¾"	12"	16"	56"
14"	17"	20¾"	17"	14"	17"	61¼"

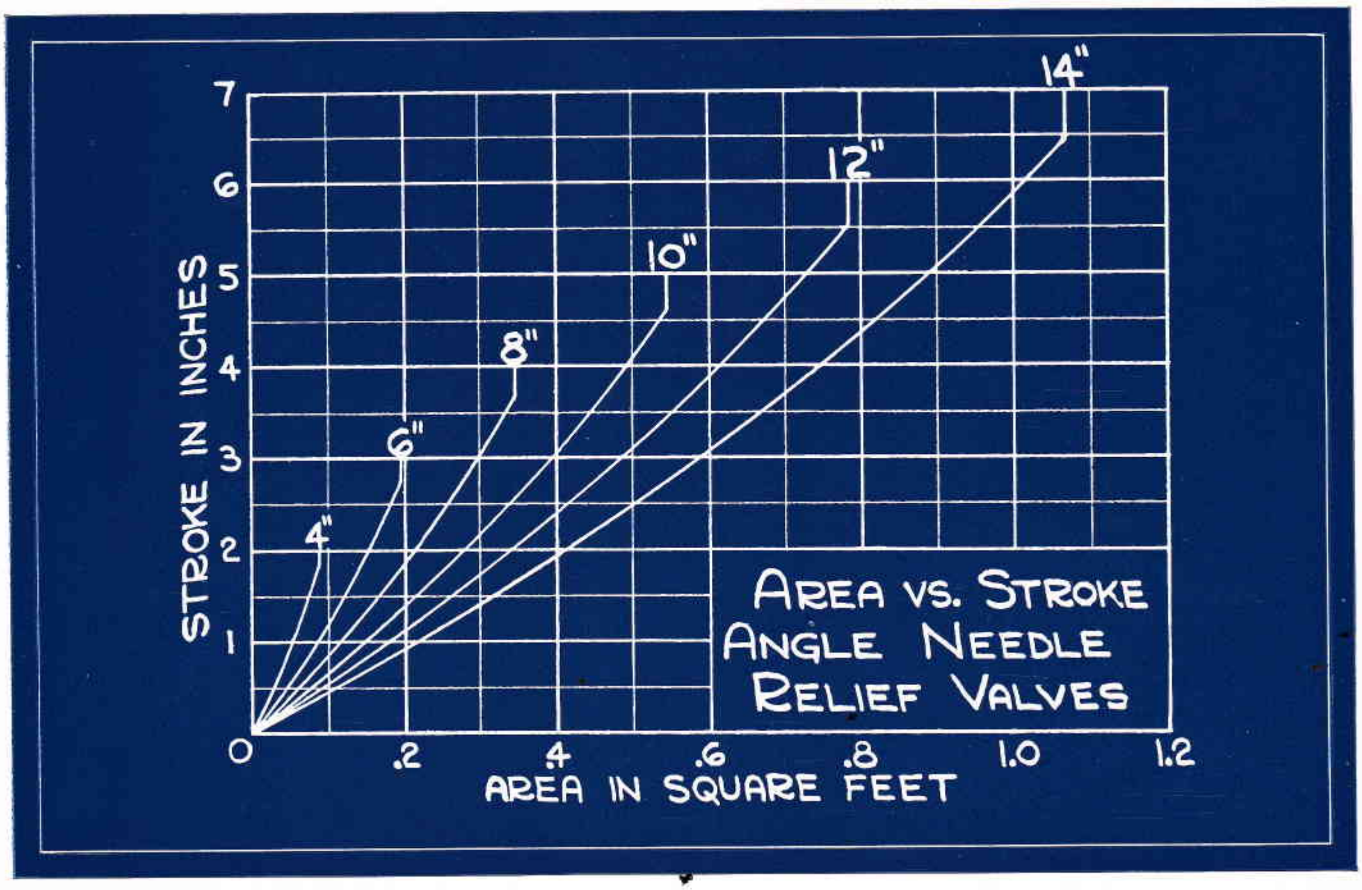


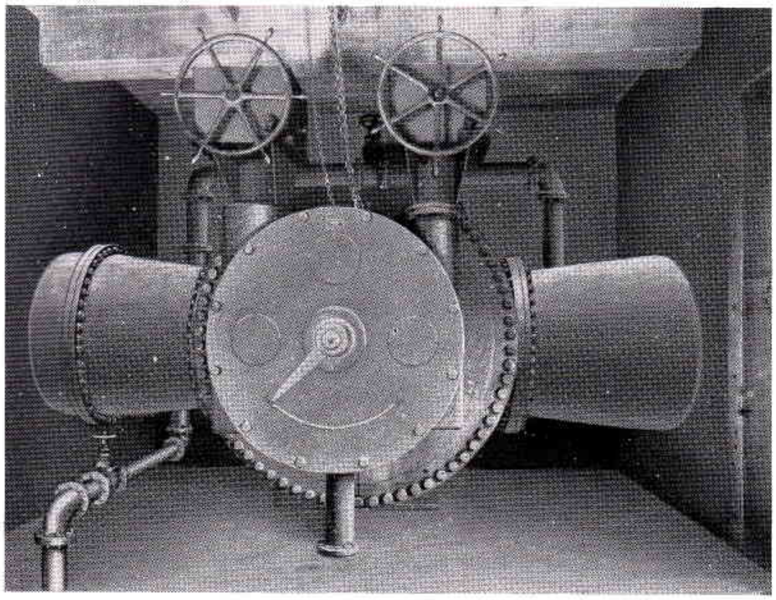
STANDARD ANGLE NEEDLE
RELIEF VALVES, 8" TO 14".



TYPICAL INSTALLATION OF RELIEF MANIFOLD HEADERS SHOWING BATTERY OF RELIEF VALVES.


DISCHARGE IN THOUSANDS OF G.P.M.
0 10 20 30 40 50
400 300 200 100 0
HEAD IN FEET
4" 6" 8" 10" 12" 14"
DISCHARGE VS. HEAD
ANGLE NEEDLE
RELIEF VALVES
20 40 60 80 100 120
DISCHARGE IN C.F.S.


7 6 5 4 3 2 1 0
STROKE IN INCHES
4" 6" 8" 10" 12" 14"
AREA VS. STROKE
ANGLE NEEDLE
RELIEF VALVES
.2 .4 .6 .8 1.0 1.2
AREA IN SQUARE FEET



Installation of a 60″ manual re-seating ROTOVALVE, controlling the water supply to the Moffat Tunnel at West Portal, Colorado.

Evaluation of Check Valves

PAGES 12 to 23, inclusive, fully cover the proper use of the various types of automatic check valves and controls and in addition a description of their design and general advantages.

It is common practice to install automatic check valves on the immediate discharge nozzles of pumping units. However, there are many cases where check valves on force mains have been located at points elsewhere than on the pump discharges.

There is a definite reason beyond that of controlling pressure waves or water hammer for installing conical plug valves. It is the fact that the loss of head through a ROTOVALVE is negligible. Hence the saving in operating costs usually justifies the initial investment.

Assume, for example, the overall efficiency of the pump and motor is 75%. Then the formula for determining the kilowatt input to the pump motor is $KW = .175 \times H \times MGD$; in which H is the head pumped in feet and MGD is the rate of pumping in million gallons per day.

Assume a rate of pumping of 10 MGD with a pump discharge nozzle of 16″ and a power cost of 1 cent/KWH. The loss through a gate valve is .68′ (see page 83) and the loss through a swing check valve is 3.30′ (see page 84), making a total loss of 3.98′. The loss through a cone valve is found to be .086′ (see page 82). Then subtracting .086′ from 3.98′, it is found that a 16″ ROTOVALVE saves 3.90′ pumping head over the gate and swing check valve combination.

This saving in head represents a decreased power demand of $.175 \times 3.9 \times 10 = 6.825$ KW or a financial saving of 6.825 cents per hour. Based upon an operation of 4,000 hours per year, it will be seen that the ROTOVALVE effects an annual saving of $273.00. Capitalizing this saving at 10%, an additional expenditure of $2,730.00 for a conical plug valve is justified.

However, the cost of a 16″ ROTOVALVE, less allowance for the gate and swing check valve, is considerably under the evaluated figure and includes many other important advantages.

Application of *Pressure Reducing* VALVES

PAST experience has proved conclusively that the use of any type of valve having an area equal to pipe line area is not practical, particularly in lines 16" and larger. To use such a valve will seriously impair the range of control.

If there is a wide range of variation of pressure either on the high pressure or the low pressure side or on both sides of the valve, the range of regulation will be broad. Regulating ranges are governed primarily by the size of the valve used. If a conical plug valve is considered, the smallest valve for the required capacity will give the closest range of regulation.

The cause of this fact is that with a smaller valve, each increment of plug movement represents but a small percentage of the line area. This percentage, however, is a variable component, which depends upon the particular position of the plug at the time of demand. A comparison curve showing valve cut-off characteristics will be found at the bottom of page 86.

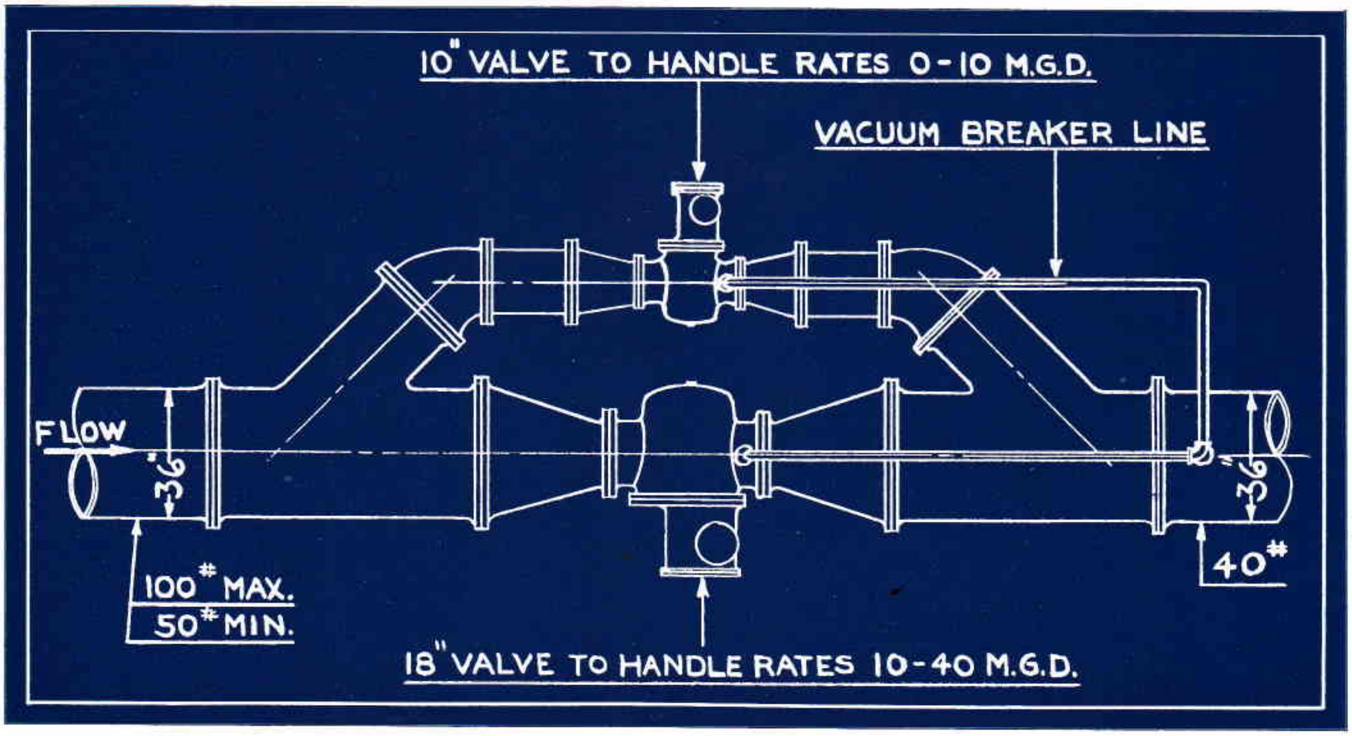
In many cases of pipe line installations 16" and larger, it has been found advisable to divide the lines where they pass through the control stations. An example is shown on the drawing on this page. The division should be made following a study of the cost and flexibility of operation. The range of pressure variation and the range of flow characteristics naturally become a part of such a study. It is often found that a battery of smaller regulating valves will give a more flexible system of control than a large valve of equal capacity. The total cost of the smaller valves seldom exceeds that of the single large valve.

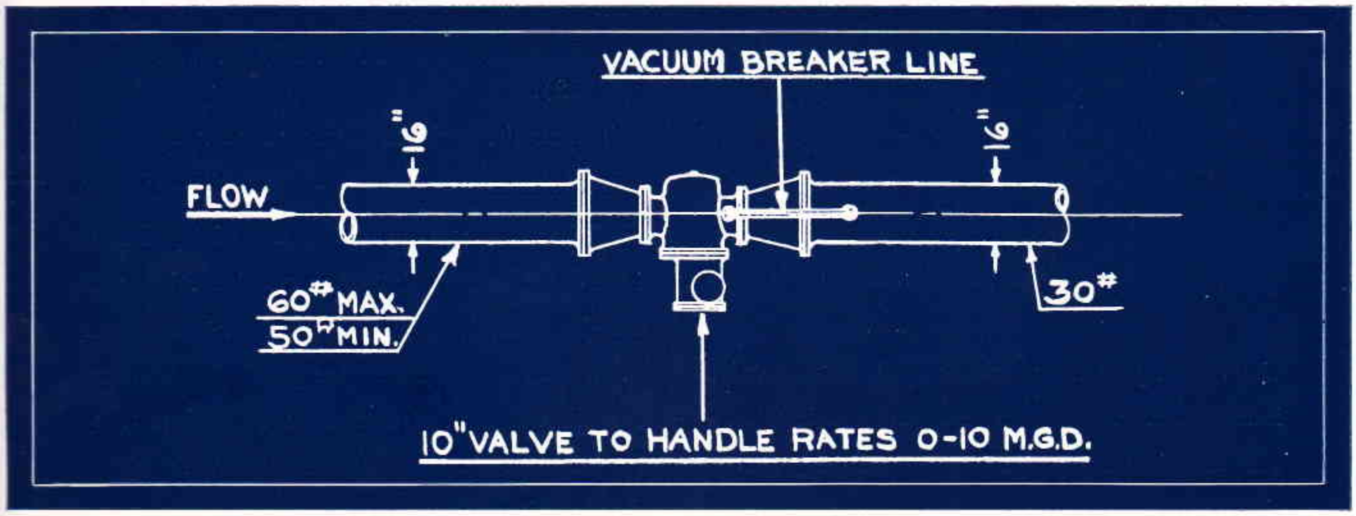
The following is an example of a theoretical installation utilizing two valves for the controlling of a pipe line having a variation in flow from 2 to 40 M.G.D.

Example: A divided 36" line: Flow, maximum—40 M.G.D. = Velocity 8.76 f.p.s. Flow, minimum—2 M.G.D. = Velocity 0.44 f.p.s. High pressure, 50 to 100 lbs. Reduced to 40 lbs. on the low pressure side.

This is a case where a 36" valve would not be practical as the curves on page 88 will show. At the minimum flow the valve would be nearly closed, hence a slight movement of the plug would reflect a large portion of the demand at this low rate. The drawing at the bottom of the page shows a satisfactory solution and a suggested layout. By setting the low pressure control of the larger valve slightly higher than that of the smaller valve, the lower rates of flow would be carried entirely by the smaller valve. However, there are many other combinations of valves which will also lend themselves to close and accurate regulation.

The drawing on page 75 is a typical example of the use of a single valve of less diameter than that of the pipe line in which it is installed. In this case the maximum flow assumed is 10 M.G.D. with a minimum flow of 1 M.G.D. irrespective of the pressure setting, it will be noted

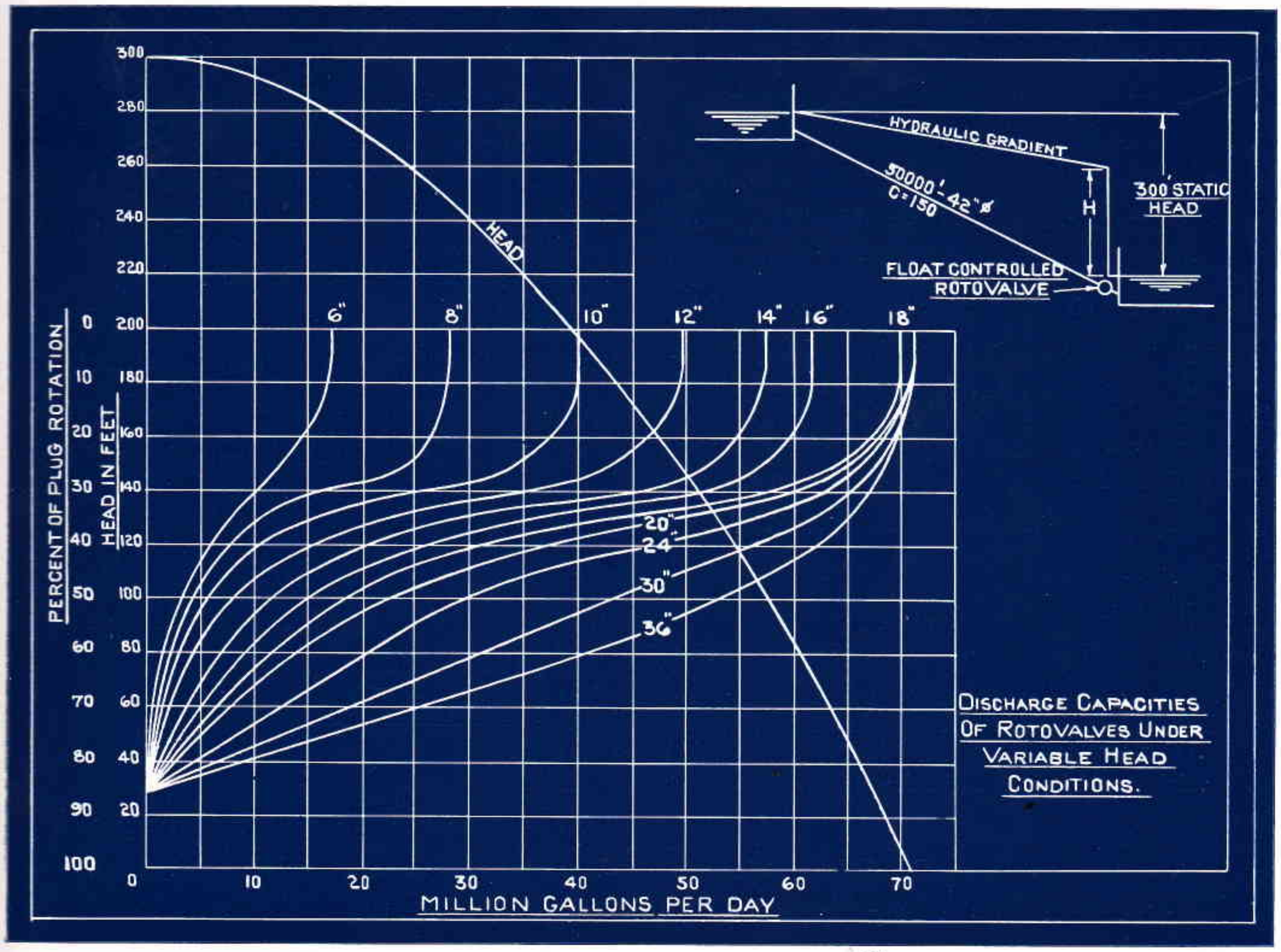




that the per cent of valve movement versus the per cent of area cut-off shows a reasonably accurate and dependable range of pressure control throughout approximately 80% of the valve movement.

The variation of control at the low rates will be slightly broader when the flows are from 0 to 2 M.G.D. However, this is a case where it would probably not be economical to divide the line.

By referring to the curves of discharge capacities of ROTOVALVES under variable heads, as shown below, a selection can easily be made of the proper size of valve or valves, depending upon the variation in gradients, and the pipe line sizes.



Rotovalves Versus Gate Valves

THE same general principles apply to stop valve installations as apply to pressure reducing, pressure relief or flow control valves with regards to size versus flow.

On pages 74 and 75 illustrations of this relationship with respect to pressure reducing valves will be found. However, there are many times when head loss is of no importance and still greater reductions in size can be made with corresponding reductions in initial cost.

With the recent development in the design of the operating heads of ROTOVALVES, whereby they can be completely enclosed and buried in the ground without the cost of building vaults, it becomes still more practical and economical to use ROTOVALVES for shutoff purposes. This applies particularly to locations of importance such as intersections or other strategic points.

In making a decision as to the economic evaluation of one installation against another, a comparison of the head losses involved must be made.

Since the loss through a ROTOVALVE is less than that through a gate valve of the same size, it is feasible to substitute a much smaller size ROTOVALVE. In such a situation the cone valve would be placed in the throat of a venturi section.

The loss through the ROTOVALVE installation is composed of the following factors:

1. Loss through the reducing section.
2. Loss through the ROTOVALVE (see page 82).
3. Loss through the increaser section.

Experiments made and published by Prof. A. H. Gibson now of the University of Manchester in England show that in venturi sections contraction loss is negligible and that expansion loss accounts for the major portion of the total loss. It was further found that the loss was a function of the included angle of divergence. A coefficient of loss "C" was established for various angles.

C = .13 for 6° included angle
C = .15 for 8° included angle
C = .17 for 10° included angle
C = .21 for 13° included angle
C = .27 for 15° included angle
C = .42 for 20° included angle
C = .60 for 25° included angle
C = .80 for 30° included angle

As stated above the loss through the reducing section may be neglected for rough estimate. However, where more exact calculation is desired, this loss may be assumed to be equivalent to the friction loss through an equal length of straight pipe, the diameter of which is equal to the mean diameter of the reducing section. Prof. Gibson evolved the following formula for the determination of the loss in a diverging section. Wall friction was taken into account in establishing the coefficient "C".

$$\text{Loss} = \frac{C(V_{TH} - V_{EN})^2}{2g}$$

Where

V_{TH} = Velocity in f.p.s. at the venturi throat

V_{EN} = Velocity in f.p.s. at the venturi entrance

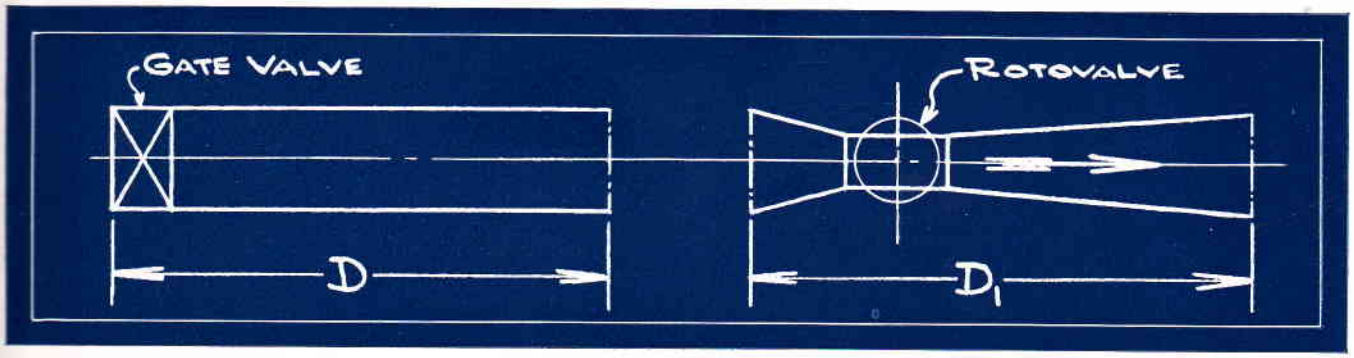
C = Loss coefficient

To the above result must be added the loss through the ROTOVALVE and through the converging section.

This total loss must be compared to the sum of the loss through the gate valve and through a length of straight pipe equal to the combined length of the venturi sections and the ROTOVALVE less the length of the gate valve.

Inasmuch as the difference in cost between a straight piece of pipe and a venturi section is not great, it is often advantageous where space will permit to use a small angle of divergence in the venturi. Eight degrees have generally proven satisfactory. Where space is limited the minimum size of the ROTOVALVE is determined by the divergence angle of the increaser. In regard to the angle of convergence of the reducing section, it has been found that 30 degrees is satisfactory.

In general, experience has shown that equal losses occur in a venturi assembly in which the diameter of the ROTOVALVE at its throat is seven-tenths the diameter of the gate valve with its proportionate length of straight pipe.



EXAMPLES

Q = 50 M.G.D. Compare a 42″ gate valve with a 30″ cone valve.

42″ Gate Valve

Gate Valve	Length = 2′-9″	Loss = .234′
Pipe	Length = 11′-7″	Loss = .076′
Total	Length = 14′-4″	T. Loss = .310′

30″ Cone Valve

Converging Sec.	Length = 2′-0″	Loss = .028′
Cone Valve	Length = 5′-4″	Loss = .130′
Diverging Sec.	Length = 7′-0″	Loss = .138′
Total	Length = 14′-4″	T. Loss = .296′

Cone Valve Saves .014′

Q = 40 M.G.D. Compare a 36″ Gate Valve with a 24″ cone valve.

36″ Gate Valve

Gate Valve	Length = 2′-4″	Loss = .303′
Pipe	Length = 11′-4″	Loss = .104′
Total	Length = 13′-8″	T. Loss = .407′

24″ Cone Valve

Converging Sec.	Length = 2′-0″	Loss = .045′
Cone Valve	Length = 4′-8″	Loss = .223′
Diverging Sec.	Length = 7′-0″	Loss = .277′
Total	Length = 13′-8″	T. Loss = .545′

Gate Valve Saves .138′

VALVE SIZES

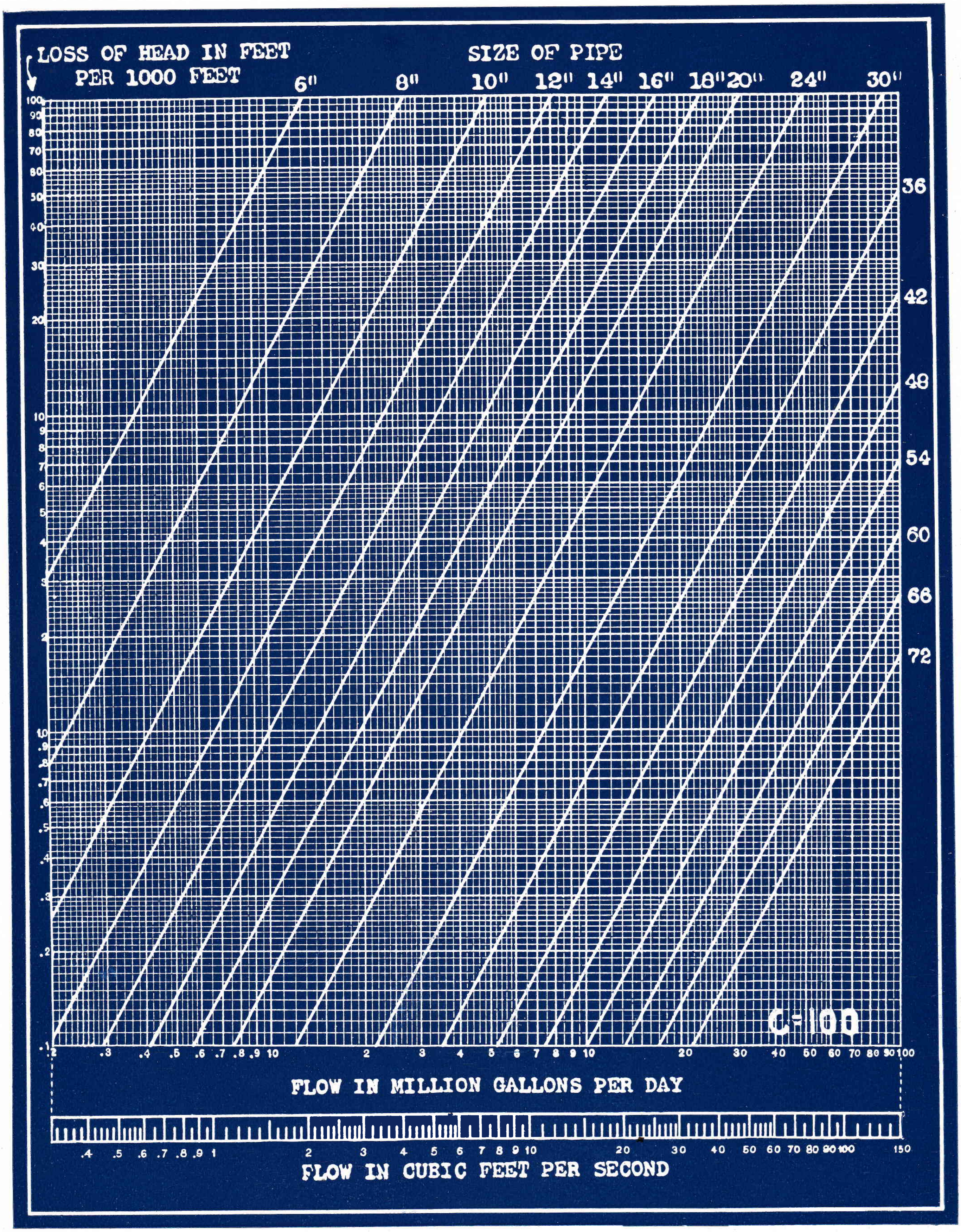
Millions of Gallons per 24 Hours	4″	6″	8″	10″	12″	14″	16″	18″	20″	24″	30″	36″	42″	48″	54″	60″	72″	84″
.05	0.88	0.39	0.22															
.06	1.07	0.47	0.27															
.07	1.26	0.55	0.31	0.20														
.08	1.45	0.63	0.36	0.23														
.09	1.61	0.71	0.40	0.25	0.18													
.10	1.78	0.79	0.44	0.28	0.20	0.15	0.11	0.09	0.07									
.11	1.96	0.87	0.49	0.31	0.22	0.16	0.12	0.10	0.08									
.12	2.15	0.95	0.54	0.34	0.24	0.17	0.13	0.10	0.09									
.13	2.30	1.02	0.58	0.37	0.26	0.19	0.15	0.11	0.09									
.14	2.49	1.10	0.62	0.40	0.28	0.20	0.16	0.12	0.10									
.15	2.67	1.18	0.67	0.43	0.30	0.22	0.17	0.13	0.11									
.20	3.56	1.58	0.89	0.57	0.39	0.29	0.22	0.17	0.14	0.10	0.06							
.30	5.34	2.36	1.33	0.85	0.59	0.43	0.33	0.26	0.21	0.15	0.10							
.40	7.12	3.15	1.77	1.13	0.79	0.58	0.44	0.35	0.28	0.20	0.13	0.09						
.50	8.80	3.94	2.22	1.42	0.99	0.72	0.55	0.44	0.35	0.25	0.16	0.11						
.60	10.70	4.73	2.66	1.70	1.18	0.87	0.66	0.52	0.43	0.30	0.19	0.13						
.70	12.60	5.52	3.10	1.99	1.38	1.01	0.77	0.61	0.50	0.35	0.22	0.15						
.80	14.50	6.30	3.55	2.27	1.58	1.16	0.88	0.70	0.57	0.39	0.25	0.18						
.90	16.10	7.09	3.99	2.55	1.77	1.30	0.99	0.79	0.64	0.44	0.28	0.20						
1.00	17.80	7.88	4.43	2.84	1.97	1.45	1.11	0.88	0.71	0.49	0.32	0.22	0.16	0.12	0.10	0.08	0.06	0.04
2.00	35.60	15.76	8.86	5.67	3.94	2.90	2.22	1.75	1.42	0.98	0.63	0.44	0.32	0.24	0.19	0.16	0.11	0.08
3.00	53.40	23.64	13.30	8.51	5.91	4.35	3.33	2.63	2.13	1.48	0.95	0.66	0.48	0.36	0.29	0.24	0.16	0.12
4.00	71.20	31.52	17.72	11.35	7.88	5.79	4.43	3.50	2.84	1.97	1.26	0.88	0.64	0.49	0.39	0.32	0.22	0.16
5.00	88.00	39.40	22.16	14.18	9.85	7.24	5.54	4.38	3.55	2.46	1.58	1.09	0.80	0.62	0.49	0.40	0.27	0.20
10.00		78.80	44.30	28.36	19.70	14.48	11.08	8.76	7.09	4.92	3.15	2.19	1.61	1.23	0.97	0.79	0.55	0.40
20.00			88.60	56.12	39.40	28.96	22.16	17.50	14.18	9.85	6.30	4.38	3.22	2.46	1.95	1.58	1.09	0.80
30.00				85.18	59.10	43.48	33.24	26.26	21.27	14.77	9.46	6.57	4.82	3.69	2.92	2.36	1.64	1.21
40.00					78.80	57.92	44.32	35.00	28.36	19.70	12.61	8.76	6.45	4.92	3.89	3.15	2.19	1.61
50.00						72.40	55.40	43.76	35.45	24.62	15.75	10.95	8.04	6.16	4.86	3.94	2.74	2.01
100.00								87.52	70.90	49.24	31.50	21.90	16.08	12.31	9.73	7.88	5.47	4.02
200.00											63.00	43.80	32.16	24.62	19.46	15.76	10.94	8.04

VELOCITY IN FEET PER SECOND
THROUGH PIPE OR ROTOVALVES.

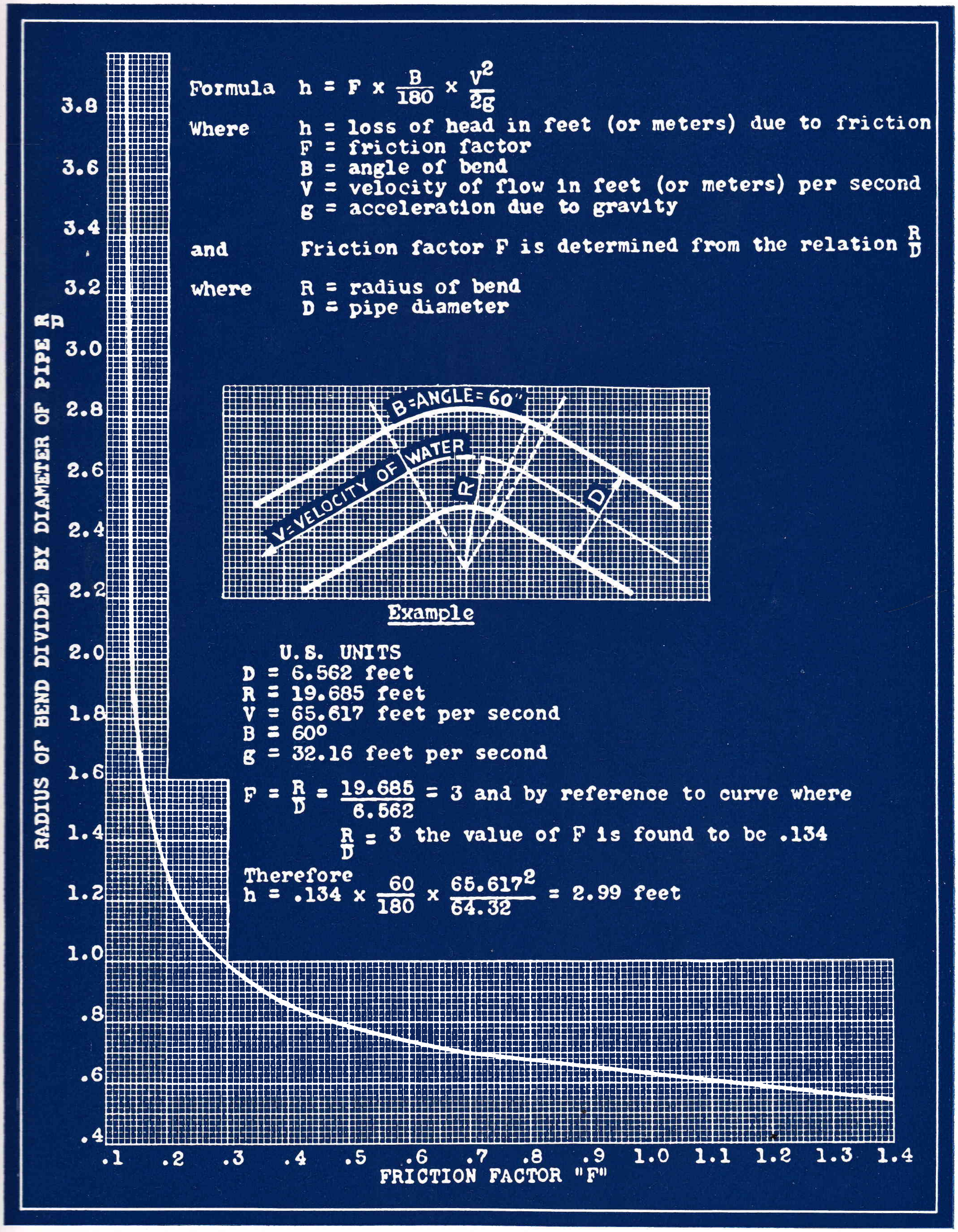
DISCHARGE IN CUBIC FEET PER SECOND

NET HEAD AT ORIFICE Lbs.	NET HEAD AT ORIFICE Feet	Velocity of Discharge In Feet per Second	6″	8″	10″	12″	14″	16″	18″	20″	24″	30″	36″	42″	48″	54″	60″	72″	84″	96″
10	23.1	38.58	7.57	13.47	21.0	30.30	41.1	53.8	68.2	84.2	122	190	273	370	484	613	755	1089	1489	1935
15	34.7	47.25	9.25	16.50	25.8	37.08	50.2	65.2	83.6	103.1	148	232	336	453	593	750	923	1332	1838	2367
20	46.2	54.55	10.70	19.03	29.8	42.75	58.1	75.4	96.7	119.0	170	269	385	524	685	869	1064	1537	2103	2742
25	57.8	60.99	11.86	21.33	33.2	47.8	65.0	84.2	108.0	133.0	191	299	430	585	765	969	1188	1719	2353	3060
30	69.3	66.82	13.10	23.35	36.6	52.5	71.5	92.4	118.9	145.9	210	329	472	642	841	1070	1313	1905	2605	3388
35	80.9	72.16	14.13	25.15	39.3	56.7	76.9	99.5	128.0	155.8	226	354	508	692	905	1145	1408	2101	2787	3605
40	92.4	77.14	15.12	27.00	42.2	60.5	82.3	106.5	137.0	167.8	242	378	543	74[illegible]	969	1228	1505	2177	2980	3879
45	104.0	81.83	16.04	28.60	44.6	64.3	87.2	112.8	143.2	177.9	256	402	577	783	1046	1305	1613	2313	3161	4101
50	115.5	86.26	16.90	30.10	47.0	67.8	92.0	120.8	153.1	187.9	271	422	609	828	1084	1372	1699	2434	3332	4323
55	127.1	90.46	17.72	31.55	49.3	71.0	96.5	125.1	160.2	197.0	284	443	638	868	1134	1437	1780	2547	3480	4535
60	138.6	94.49	18.53	32.90	51.6	74.2	100.0	132.0	167.5	206.0	297	463	660	906	1189	1502	1859	2667	3646	4737
65	150.2	98.35	19.27	34.22	53.7	76.1	104.2	137.0	174.0	214.0	309	483	694	944	1232	1564	1939	2769	3798	4940
70	161.7	102.06	20.00	35.62	55.7	80.1	108.2	141.9	181.0	222.0	320	501	720	978	1281	1626	2010	2879	3939	5121
75	173.3	105.65	20.72	36.85	57.7	83.0	111.8	147.5	187.1	231.0	331	518	745	1013	1326	1677	2081	2980	4070	5276
80	184.8	109.11	21.40	38.08	59.6	85.7	115.4	152.6	191.3	238.0	343	536	770	1048	1363	1735	2149	3080	4210	5475
85	196.4	112.46	22.20	39.20	61.3	88.3	118.8	157.2	199.2	245.0	354	558	793	1081	1409	1788	2217	3170	4345	5635
90	207.9	115.72	22.62	40.30	62.8	90.6	124.0	161.2	203.2	252.0	363	572	815	1110	1450	1838	2275	3250	4465	5800
95	219.5	118.89	23.35	41.50	64.8	93.3	125.6	166.0	210.8	258.0	373	584	839	1130	1492	1889	2370	3355	4575	5970

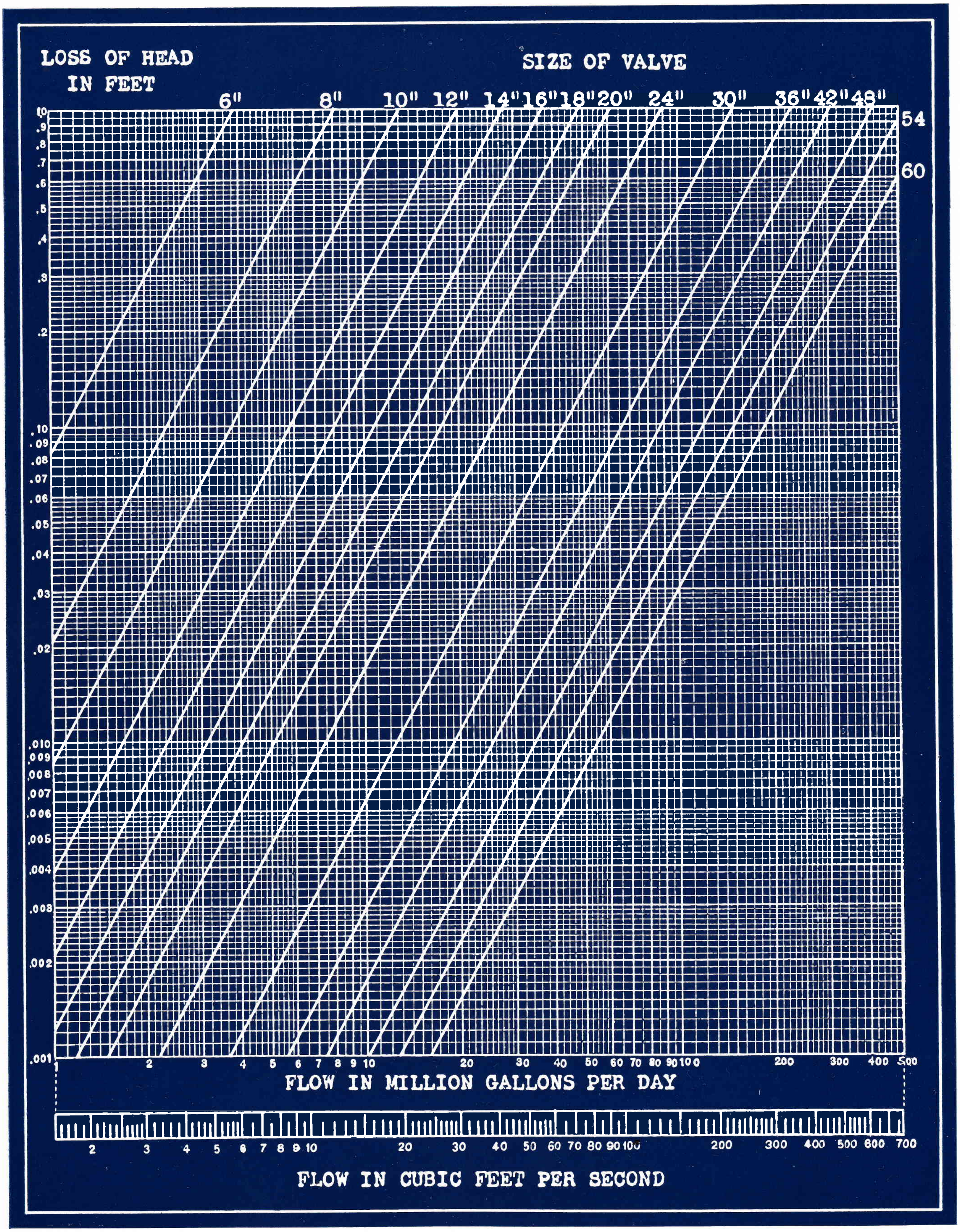
CALCULATED DISCHARGE THROUGH ROTOVALVES
BASED ON VALVE CAPACITIES ONLY.



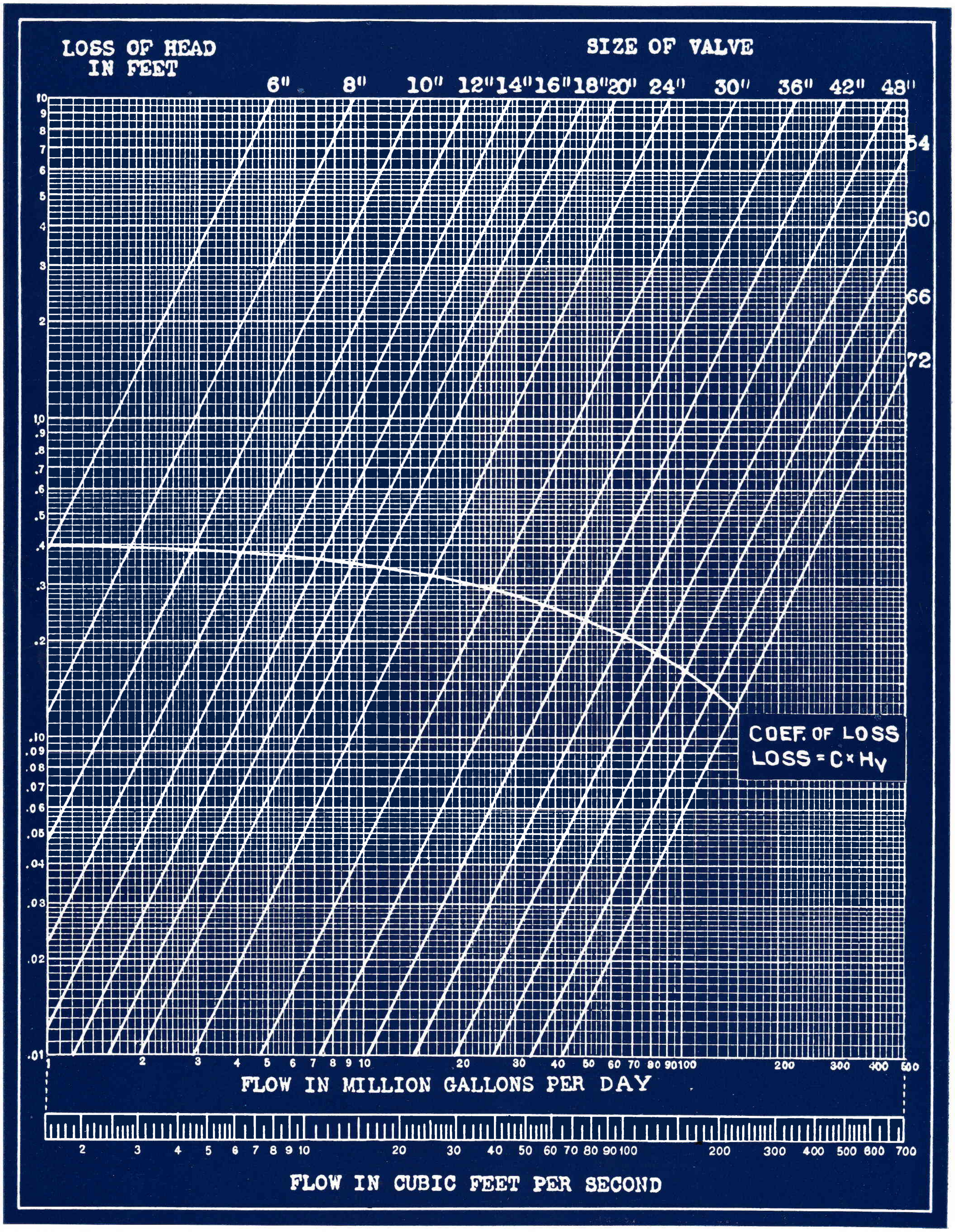
LOSS OF HEAD THROUGH PIPE.



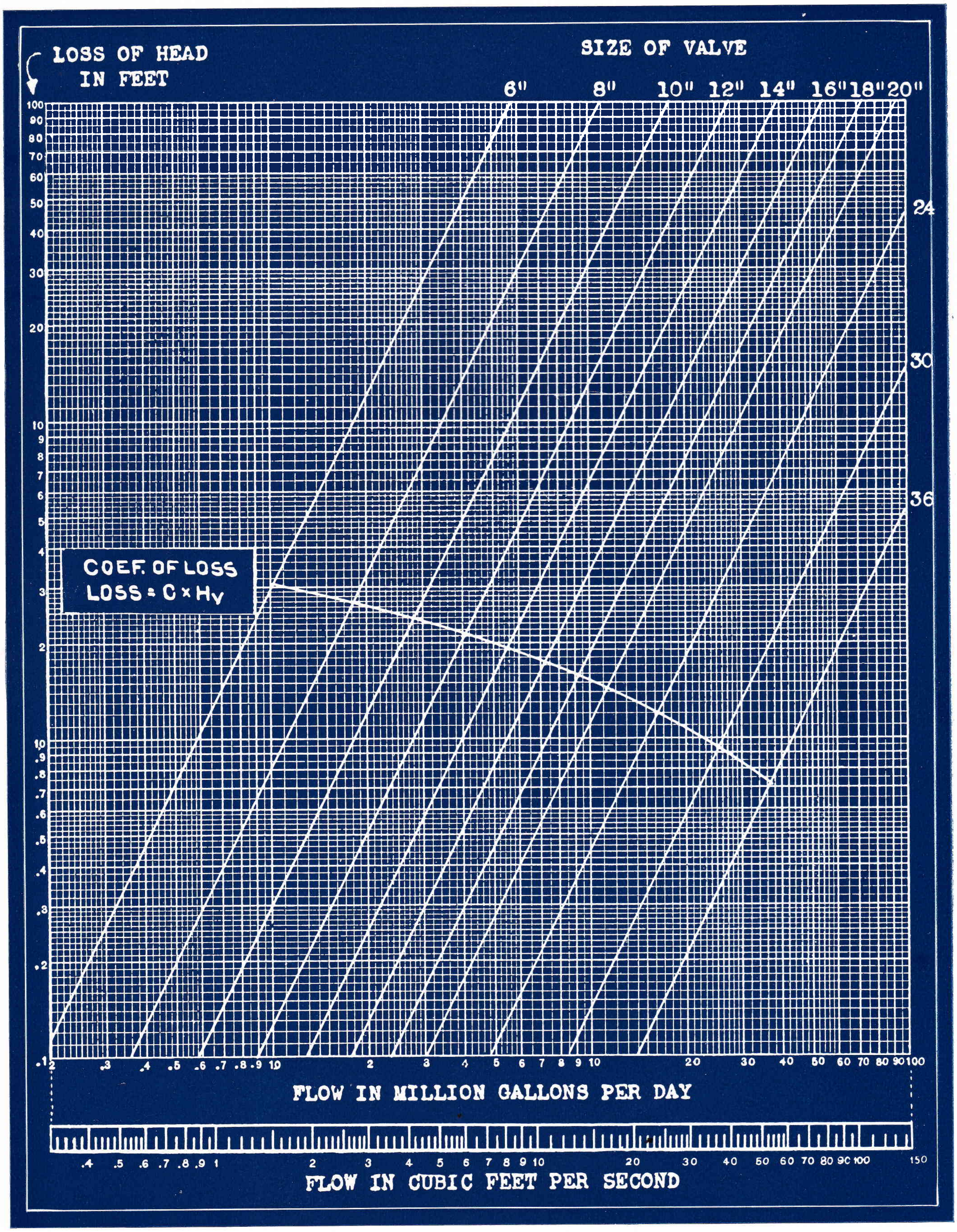
LOSS OF HEAD THROUGH PIPE BENDS.



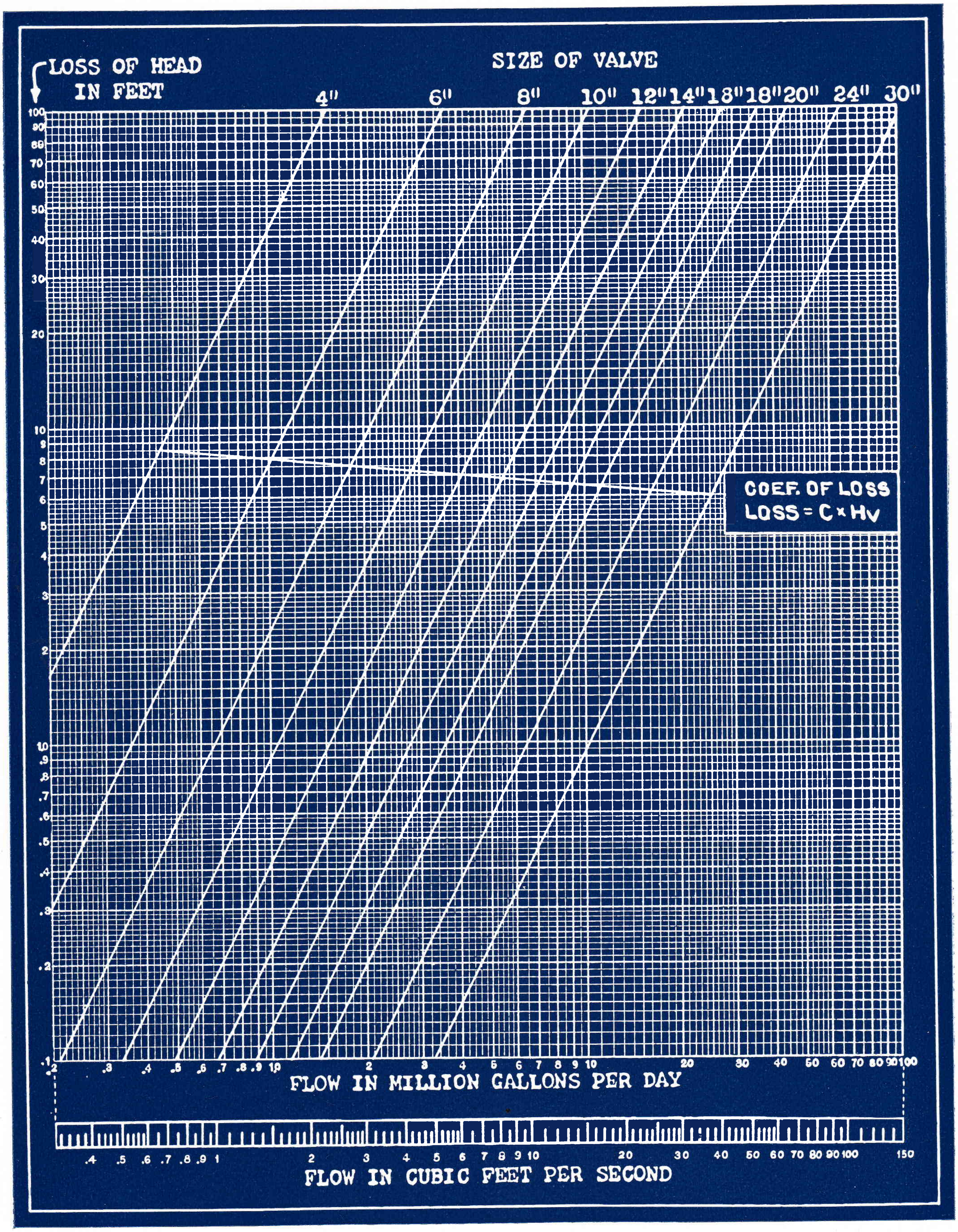
LOSS OF HEAD THROUGH ROTOVALVES.



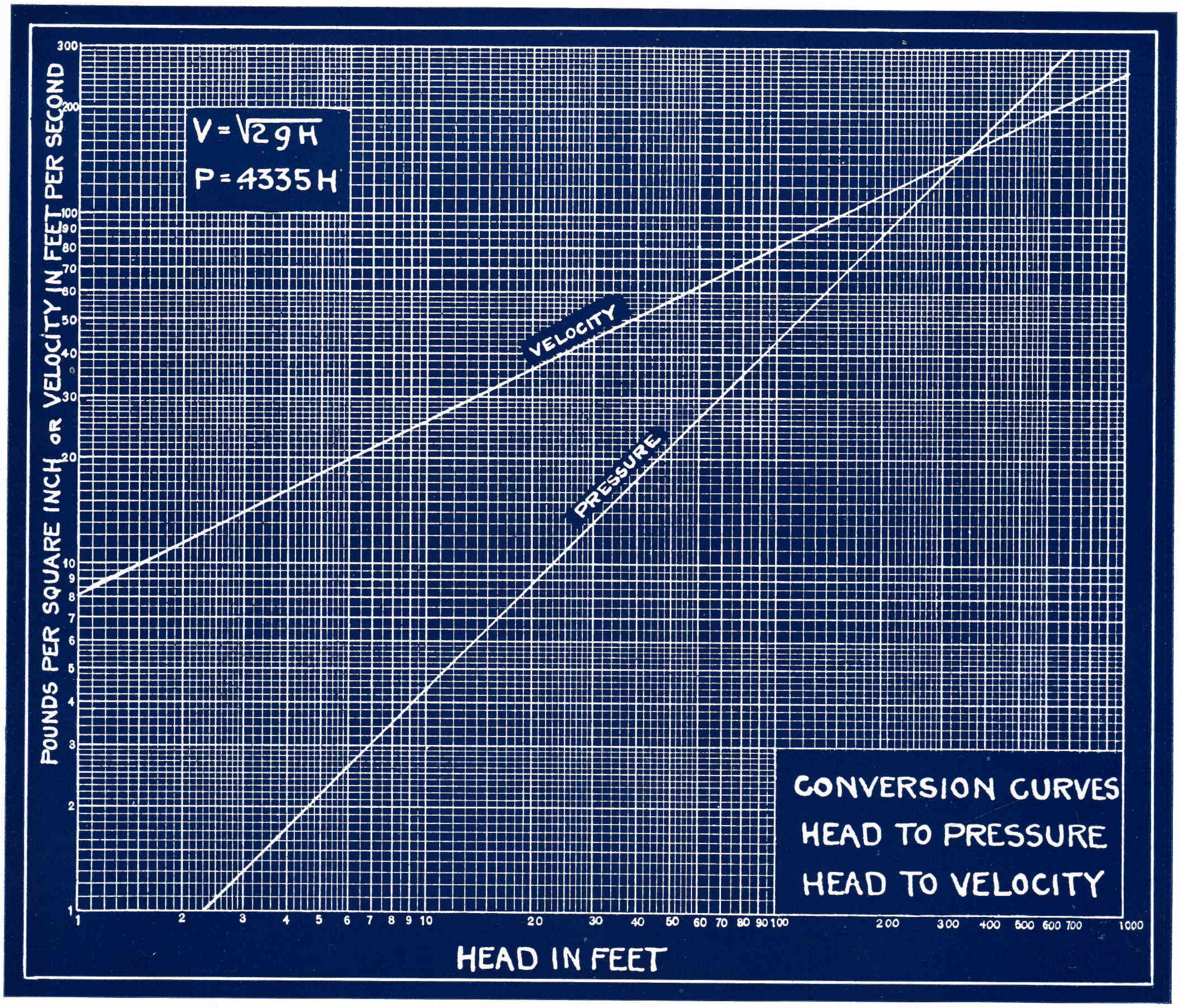
LOSS OF HEAD THROUGH GATE VALVES.

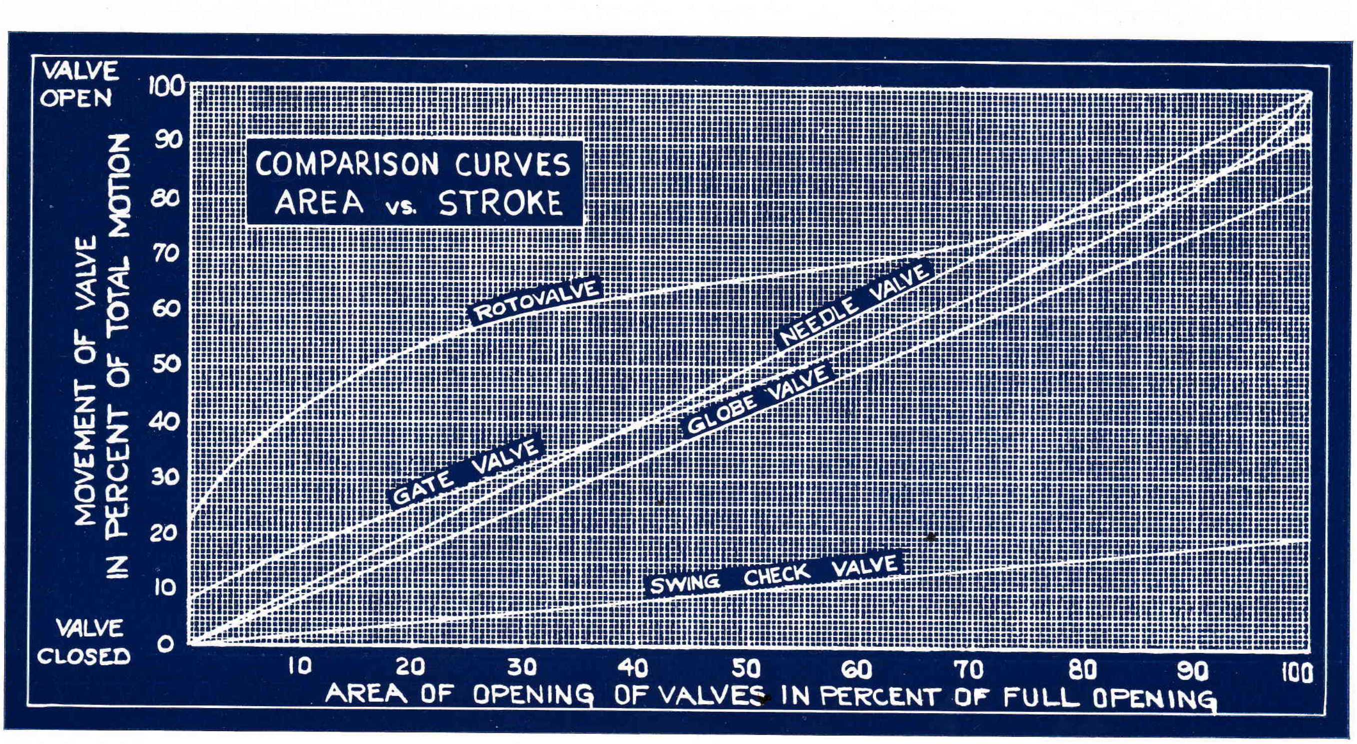


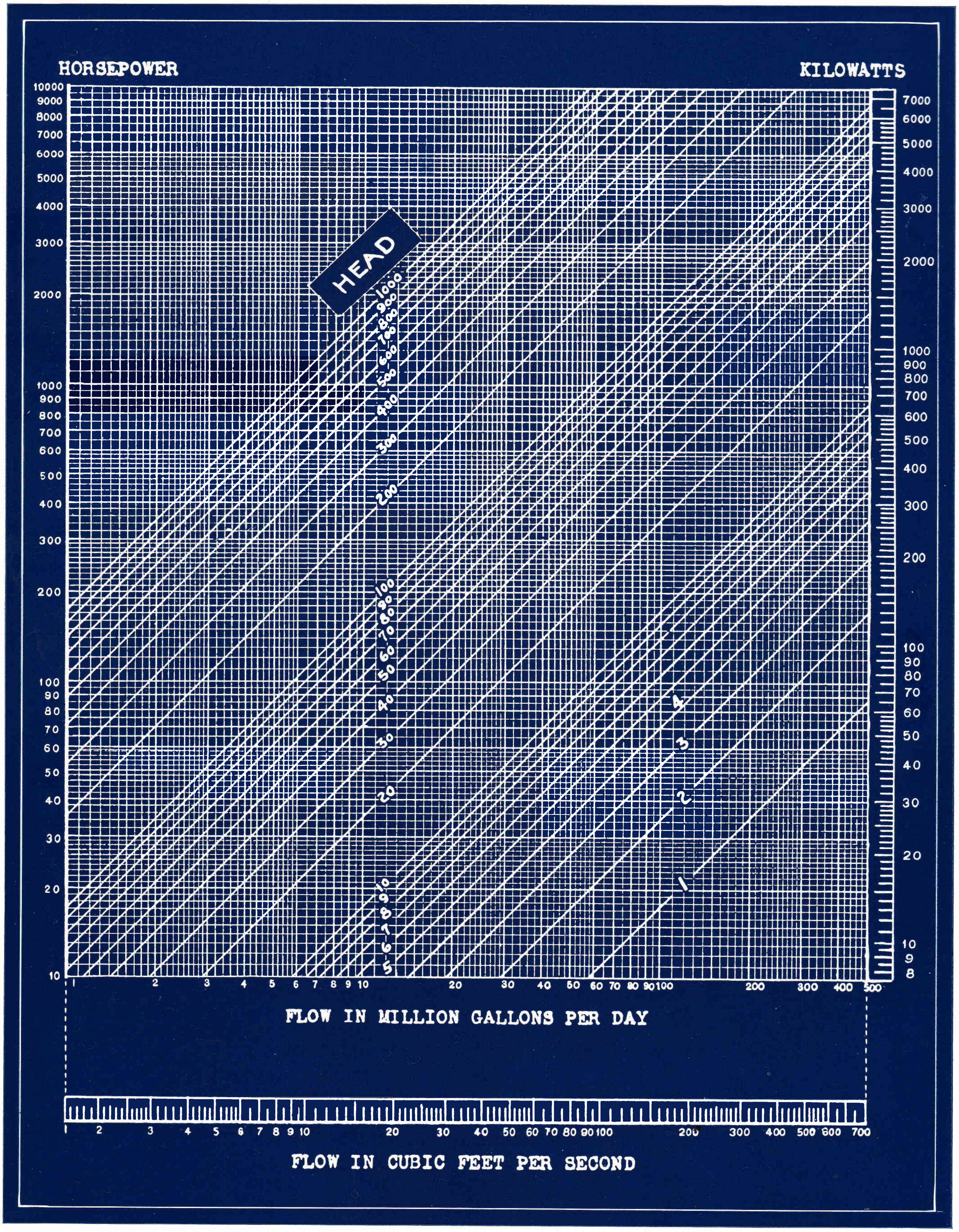
LOSS OF HEAD THROUGH SWING CHECK VALVES.



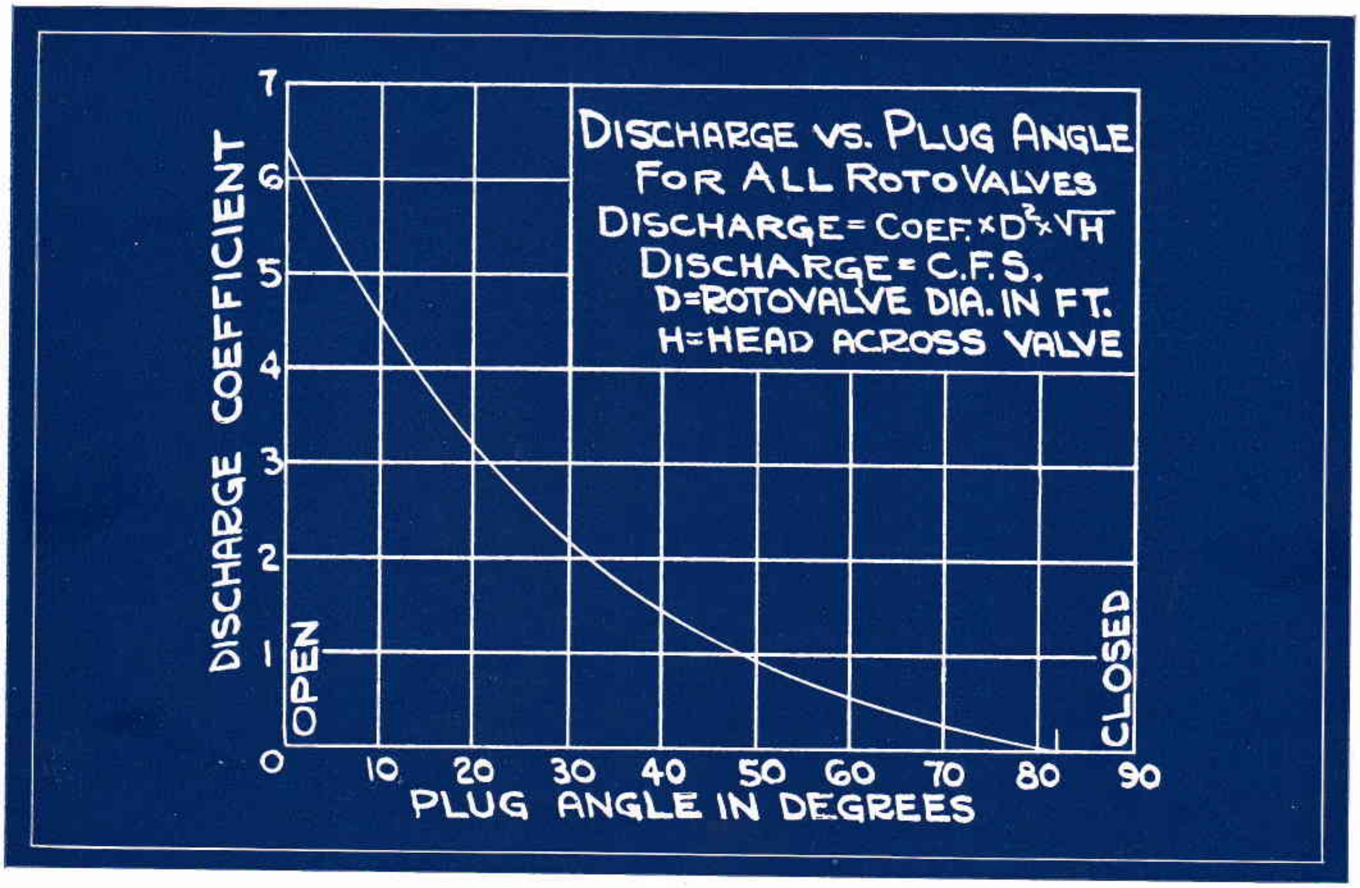
LOSS OF HEAD THROUGH GLOBE VALVES.

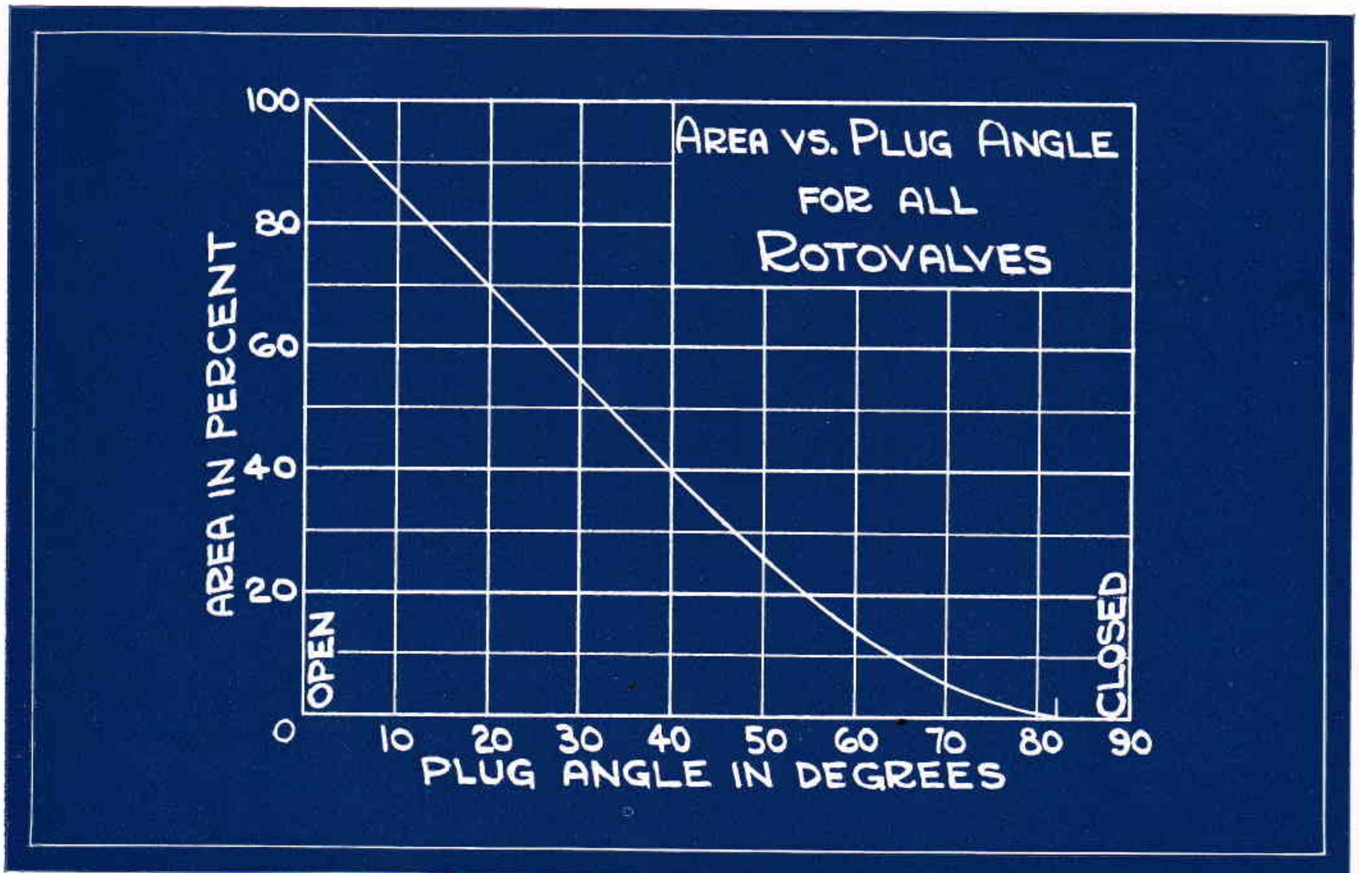

V = √2gH
P = .4335 H
VELOCITY
PRESSURE
CONVERSION CURVES
HEAD TO PRESSURE
HEAD TO VELOCITY
POUNDS PER SQUARE INCH OR VELOCITY IN FEET PER SECOND
HEAD IN FEET


COMPARISON CURVES
AREA vs. STROKE
VALVE OPEN
VALVE CLOSED
MOVEMENT OF VALVE
IN PERCENT OF TOTAL MOTION
ROTOVALVE
NEEDLE VALVE
GLOBE VALVE
GATE VALVE
SWING CHECK VALVE
AREA OF OPENING OF VALVES IN PERCENT OF FULL OPENING



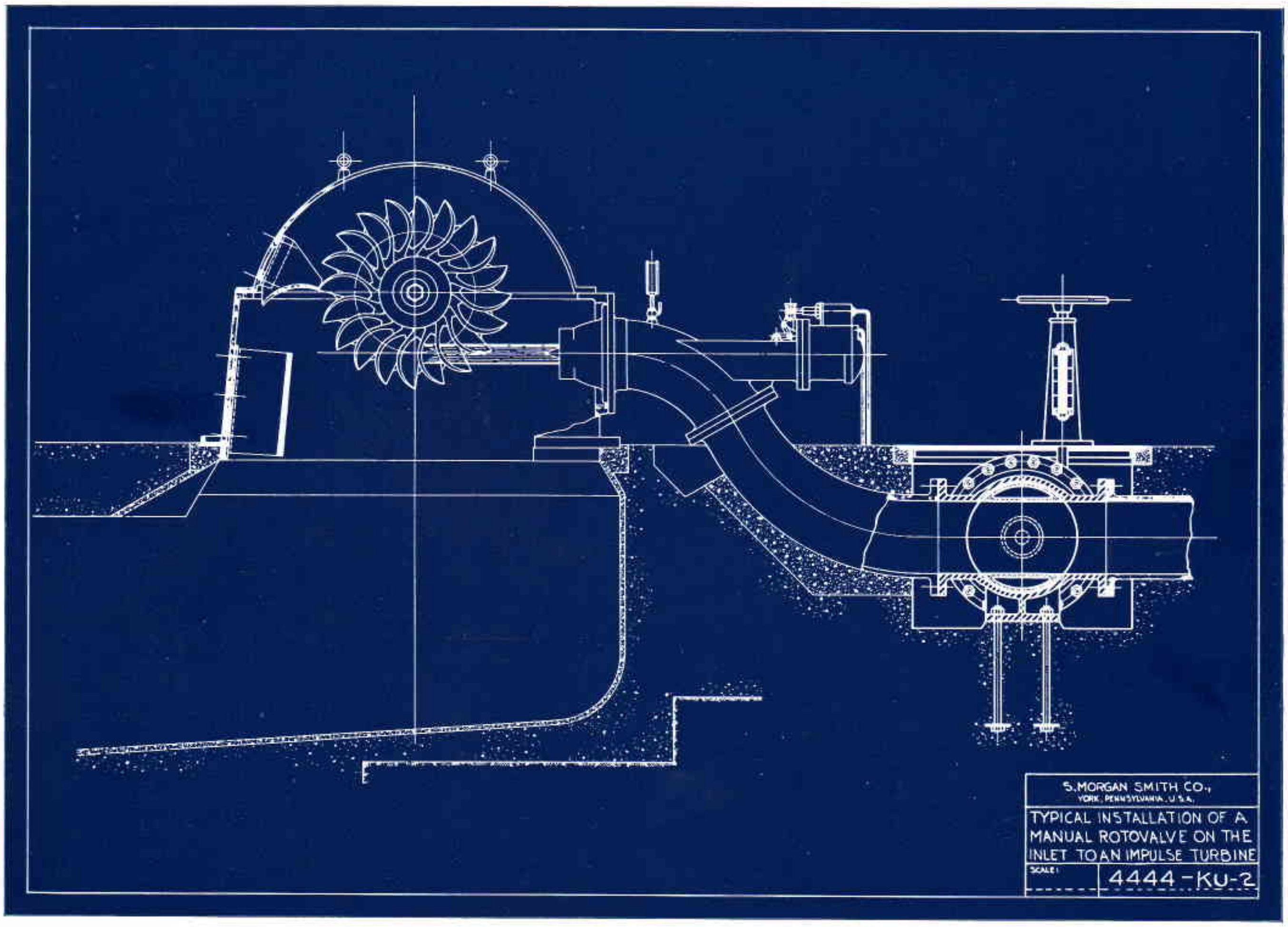
CONVERSION CURVE IN KW. AND H.P. VERSUS M.G.D. AND C.F.S.


DISCHARGE VS. PLUG ANGLE
FOR ALL ROTO VALVES
DISCHARGE = COEF. × D² × √H
DISCHARGE = C.F.S.
D = ROTOVALVE DIA. IN FT.
H = HEAD ACROSS VALVE
DISCHARGE COEFFICIENT
0
1
2
3
4
5
6
7
OPEN
CLOSED
10
20
30
40
50
60
70
80
90
PLUG ANGLE IN DEGREES


AREA VS. PLUG ANGLE
FOR ALL
ROTOVALVES
AREA IN PERCENT
0
20
40
60
80
100
OPEN
CLOSED
10
20
30
40
50
60
70
80
90
PLUG ANGLE IN DEGREES

CIRCUMFERENCE AND AREAS OF CIRCLES

Dia. Inches	Circum.	Area	Dia. Inches	Circum.	Area	Dia. Inches	Circum.	Area
4	12.56	12.56	25	78.54	490.9	67	210.48	3525.7
4½	14.14	15.90	26	81.68	530.9	68	213.63	3631.7
5	15.70	19.63	27	84.82	572.6	69	216.77	3739.3
5½	17.28	23.76	28	87.96	615.6	70	219.91	3848.5
6	18.85	28.27	29	91.11	660.5	71	223.05	3959.2
6½	20.42	33.18	30	94.25	706.9	72	226.19	4071.5
7	21.99	38.48	31	97.39	754.8	73	229.34	4185.4
7½	23.56	44.18	32	100.53	804.2	74	232.48	4300.8
8	25.13	50.26	33	103.67	855.3	75	235.62	4417.9
8½	26.70	56.74	34	106.81	907.9	76	238.76	4536.5
9	28.27	63.61	35	109.96	962.1	77	241.90	4656.6
9½	29.84	70.88	36	113.10	1017.9	78	245.04	4778.4
10	31.41	78.54	37	116.24	1075.2	79	248.19	4901.7
10½	32.99	86.59	38	119.38	1134.1	80	251.33	5026.5
11	34.55	95.03	39	122.52	1194.6	81	254.47	5153.0
11½	36.13	103.87	40	125.66	1256.6	82	257.61	5281.0
12	37.70	113.10	41	128.81	1320.3	83	260.75	5410.6
12½	39.27	122.72	42	131.95	1385.4	84	263.89	5541.8
13	40.84	132.73	43	135.09	1452.2	85	267.04	5674.5
13½	42.41	143.14	44	138.23	1520.5	86	270.18	5808.8
14	43.98	153.94	45	141.37	1590.4	87	273.32	5944.7
14½	45.55	165.13	46	144.51	1661.9	88	276.46	6082.1
15	47.12	176.71	47	147.65	1734.9	89	279.60	6221.1
15½	48.69	188.69	48	150.80	1809.6	90	282.74	6361.7
16	50.26	201.06	49	153.94	1885.7	91	285.88	6503.9
16½	51.83	213.82	50	157.08	1963.5	92	289.03	6647.6
17	53.40	226.98	51	160.22	2042.8	93	292.17	6792.9
17½	54.98	240.53	52	163.36	2123.7	94	295.31	6939.8
18	56.55	254.47	53	166.50	2206.2	95	298.45	7088.2
18½	58.12	268.80	54	169.65	2290.2	96	301.59	7238.2
19	59.69	283.53	55	172.79	2375.8	97	304.73	7389.8
19½	61.26.	298.65	56	175.93	2463.0	98	307.88	7543.0
20	62.83	314.16	57	179.07	2551.8	99	311.02	7697.7
20½	64.40	330.06	58	182.21	2642.1	100	314.16	7854.0
21	65.97	346.36	59	185.35	2734.0	108	339.30	9160.9
21½	67.54	363.05	60	188.50	2827.4	120	376.99	11309.7
22	69.11	380.13	61	191.64	2922.5	132	414.69	13684.8
22½	70.69	397.61	62	194.78	3019.1	144	452.39	16286.0
23	72.26	415.48	63	197.92	3117.2	156	490.09	19113.4
23½	73.83	433.74	64	201.06	3217.0	168	527.79	22167.1
24	75.40	452.39	65	204.20	3318.3	180	565.49	25446.9
24½	76.97	471.44	66	207.35	3421.2	192	603.19	28952.9



CONVERSION OF UNITS OF FLOW

Million Gallons Per Day M. G. D.	Gallons Per Minute G. P. M.	Cubic Feet Per Sec. C. F. S.	Miner's Inches: Arizona Calif. Montana Oregon	Miner's Inches: Idaho Kansas Nebraska Nevada New Mex. N. Dak. S. Dak. Utah	Miner's Inches: Colorado	Acre Feet Per 24 Hours
1	694.4	1.547	61.89	77.36	59.44	3.07
0.001440	1	0.00223	0.0891	0.1114	0.0856	0.00442
0.646	448.8	1	40	50	38.4	1.983
0.0162	11.25	0.025	1	1.25	0.960	0.0496
0.01296	9.00	0.020	0.80	1	0.768	0.0397
0.0168	11.69	0.026	1.042	1.302	1	0.0516
0.3258	226.3	0.504	20.17	25.21	19.36	1

EQUIVALENTS OF MEASURE

Lengths

Meters m	Inches in.	Feet ft.	Yards yd.	Rods r.	U. S. Statute Miles	Kilometers
1	39.37	3.28083	1.09361	0.19884	$0.{}^{3}_{0}6214$	0.001
0.02540	1	0.08333	0.02778	$0.{}^{2}_{0}5051$	$0.{}^{4}_{0}1578$	$0.{}^{4}_{0}2540$
0.030480	12	1	0.33333	0.06061	$0.{}^{3}_{0}1894$	$0.{}^{3}_{0}3048$
0.91440	36	3	1	0.18182	$0.{}^{3}_{0}5682$	$0.{}^{3}_{0}9144$
5.02921	198	16.5	5.5	1	$0.{}^{2}_{0}3125$	$0.{}^{2}_{0}5029$
1609.35	63360	5280	1760	320	1	1.60935
1000	39370	3280.83	1093.61	198.838	0.62137	1

1 meter (m) = 10 decimeters (dm) = 100 centimeters (cm) = 1000 millimeters (mm)
1 meter (m) = 39.37 inches U. S. Standard = 39.370113 inches, British Standard

Surfaces and Areas

Sq. Meters m^2	Sq. Inches sq. in.	Sq. Feet sq. ft.	Sq. Yards sq. yd.	Acres A	Sq. Miles U. S. Statute	Sq. Kilometers km^2
1	1550.00	10.7639	1.19599	$0.{}^{3}_{0}2471$	$0.{}^{6}_{0}3861$	$0.{}^{5}_{0}1$
$0.{}^{3}_{0}6452$	1	$0.{}^{2}_{0}6944$	$0.{}^{3}_{0}7716$	$0.{}^{6}_{0}1594$	$0.{}^{9}_{0}2491$	$0.{}^{9}_{0}6452$
0.09290	144	1	0.11111	$0.{}^{4}_{0}2296$	$0.{}^{7}_{0}3587$	$0.{}^{7}_{0}9290$
0.83613	1296	9	1	$0.{}^{3}_{0}2066$	$0.{}^{6}_{0}3228$	$0.{}^{6}_{0}8361$
4046.87	6272640	43560	4840	1	$0.{}^{2}_{0}1563$	$0.{}^{2}_{0}4047$
2589999		27878400	3097600	640	1	2.59000
1000000		10763867	1195985	247.104	0.38610	1

1 sq. meter (m^2) = 0.01 are (a) = 0.0001 hectare (ha)

Fluid Measure

U. S. Gallon	Imperial Gallon	Liter	Cubic Inches	Cubic Feet	Cubic Yards	Pounds Water at 39.1° F.
1	0.83311	3.78543	231	0.13368	$0.{}^{2}_{0}4951$	8.34501
1.20032	1	4.54373	277.2740	0.16046	$0.{}^{2}_{0}5943$	10.01669
0.26417	0.22009	1	61.0234	0.03531	$0.{}^{2}_{0}1308$	2.20450
$0.{}^{2}_{0}4329$	$0.{}^{2}_{0}36065$	0.01639	1	$0.{}^{3}_{0}5787$	$0.{}^{4}_{0}2143$	0.036126
7.48055	6.23210	28.3170	1728	1	0.03704	62.4250
201.974	168.267	764.559	46656	27	1	1685.475
0.119832	0.099833	0.453617	27.68122	0.01602	$0.{}^{3}_{0}5933$	1

Notations: ${}^{2}_{0},\ {}^{3}_{0},\ {}^{4}_{0}$ etc., indicate that ${}^{2}_{0},\ {}^{3}_{0},\ {}^{4}_{0}$ etc. are to be replaced by 2, 3, 4, etc. ciphers. $0.{}^{4}_{0}3429 = 0.00003429$

EQUIVALENTS OF MEASURE

Masses and Weights

Kilograms kg.	Ounces		Pounds		Tons	
	Troy	Avoir.	Troy	Avoir.	Net 2000#	Metric 100 kg.
1	32.1507	35.2740	2.67923	2.20462	$0.{}^{2}_{0}1102$	0.001
0.03110	1	1.09714	0.08333	0.06857	$0.{}^{4}_{0}3429$	$0.{}^{4}_{0}3110$
0.02835	0.91146	1	0.07595	0.06250	$0.{}^{4}_{0}3125$	$0.{}^{4}_{0}2835$
0.37324	12	13.1657	1	0.82286	$0.{}^{3}_{0}4114$	$0.{}^{3}_{0}3732$
0.45359	14.5833	16	1.21528	1	0.00050	$0.{}^{3}_{0}4536$
907.185	29166.7	32000	2430.56	2000	1	0.90719
1000	32150.7	35274.0	2679.23	2204.62	0.98421	1

1 kilogram (kg) = 1 liter of water (39.1° F. 45° Lat. Sea Level)

Energy, Work, Heat

Kilogram-meters kg-m	Foot-pounds ft.-lbs.	Horsepower hour		Poncelet Hours 100-kg-m-h	Kilowatt Hours kw-h	British Thermal Units B. T. U.
		U. S., H. P.-h	Metric 75 kg-m-h			
1	7.23300	$0.{}^{5}_{0}3653$	$0.{}^{5}_{0}3704$	$0.{}^{5}_{0}2778$	$0.{}^{5}_{0}2724$	$0.{}^{2}_{0}9296$
0.13826	1	$0.{}^{6}_{0}5051$	$0.{}^{6}_{0}5121$	$0.{}^{6}_{0}3840$	$0.{}^{6}_{0}3766$	$0.{}^{2}_{0}1285$
273745	1980000	1	1.01387	0.76040	0.74565	2544.65
270000	1952910	0.98632	1	0.75	0.73545	2509.83
360000	2603880	1.31509	1.3333	1	0.98060	3346.44
367123	2655403	1.34111	1.35972	1.01979	1	3412.66
107.577	778.104	$0.{}^{3}_{0}3930$	$0.{}^{3}_{0}3984$	$0.{}^{3}_{0}2988$	$0.{}^{3}_{0}2930$	1

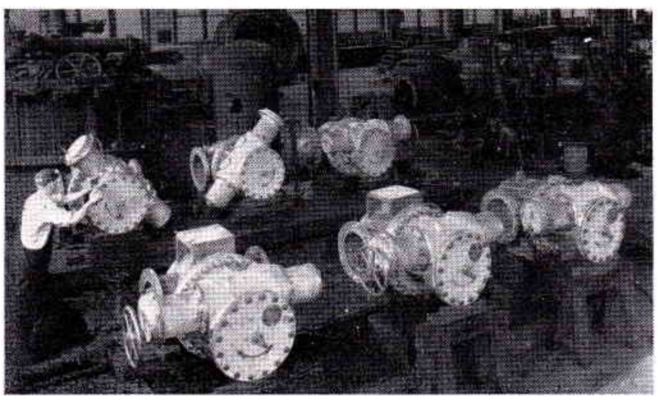
Power—Rate of Energy

Kilogram-meters /second kg-m/sec.	Foot-pounds per Second ft.-lbs./sec.	Horsepower		Poncelet 100 kg-m /sec.	Kilowatts kw.	British Thermal Units per Second B. T. U./sec.
		U. S. 550′#/sec.	Metric 75 kg-m/sec.			
1	7.2330	0.01315	0.01333	0.01	$0.{}^{2}_{0}9806$	$0.{}^{2}_{0}9296$
0.13826	1	$0.{}^{2}_{0}1818$	$0.{}^{2}_{0}1843$	$0.{}^{2}_{0}1383$	$0.{}^{2}_{0}1356$	$0.{}^{2}_{0}1285$
76.0404	550	1	1.01387	0.76040	0.74565	0.70685
75	542.475	0.98632	1	0.75	0.73545	0.69718
100	723.300	1.31509	1.3333	1	0.98060	0.92957
101.979	737.612	1.34111	1.35972	1.01979	1	0.94796
107.577	778.104	1.41474	1.43436	1.07577	1.05490	1

Notations: ${}^{2}_{0}, {}^{3}_{0}, {}^{4}_{0}$ etc., indicate that ${}^{2}_{0}, {}^{3}_{0}, {}^{4}_{0}$, etc. are to be replaced by 2, 3, 4, etc. ciphers. $0.{}^{4}_{0}3429 = 0.00003429$

The world's most powerful fire boat, recently built for the City of New York.

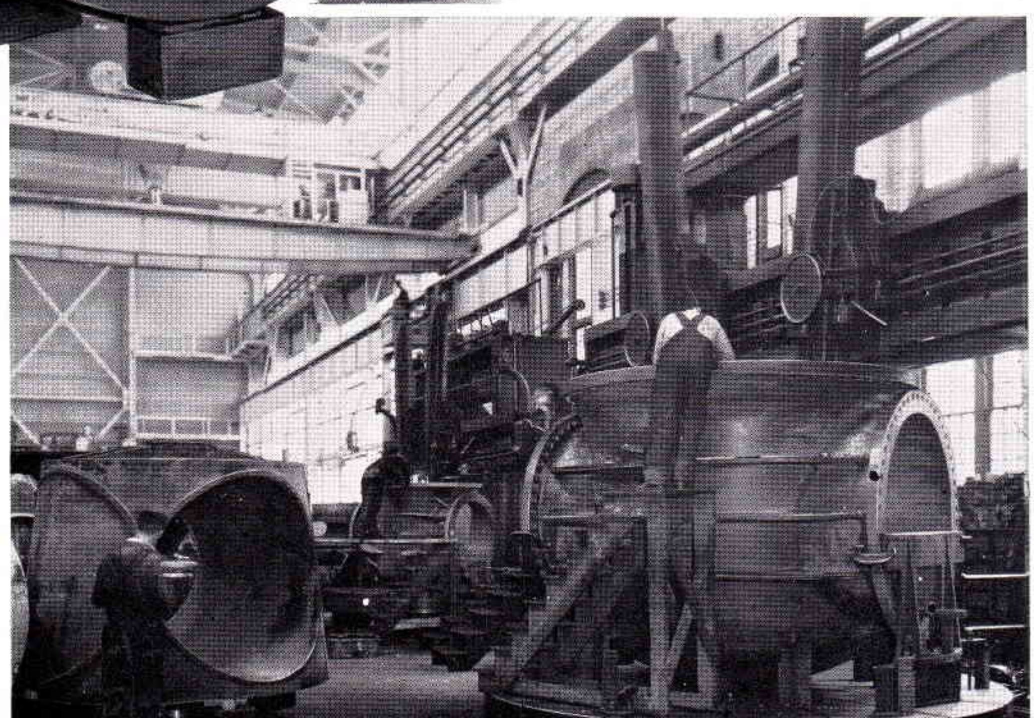
Fire Fighting



SOME of the fifteen manually operated two-way and three-way ROTOVALVES for 300 lbs. working pressure installed on this vessel. ROTOVALVES were chosen first, because of their ease and speed of operation and second, because of the great reduction in friction loss which enabled maximum pressure to be delivered at the nozzles.

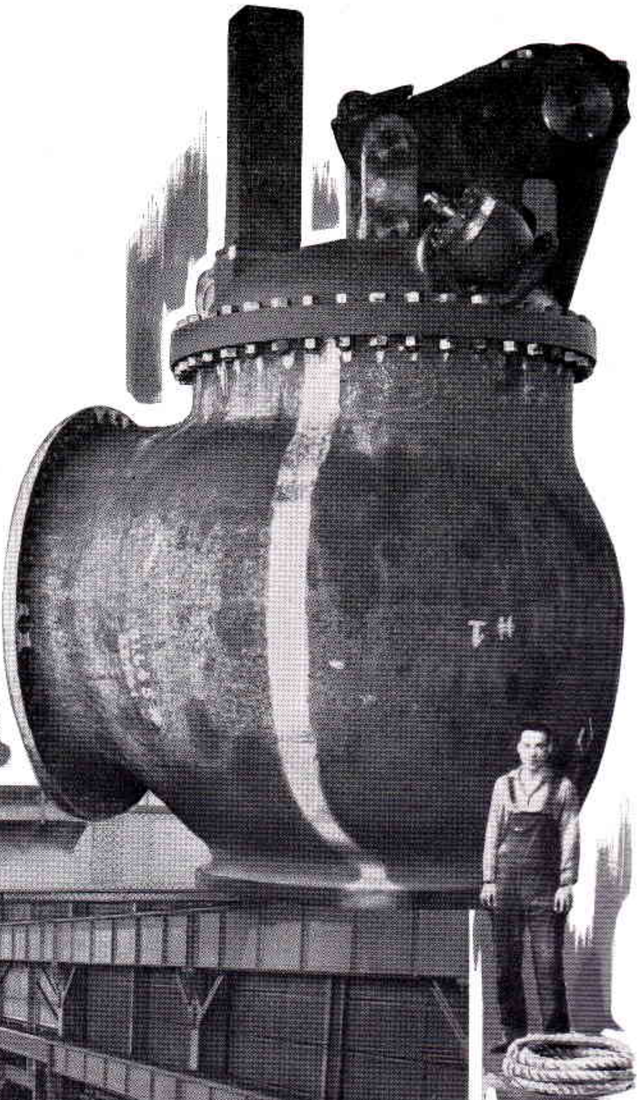
BUILDING ROTOVALVES

IN the preceding pages we have attempted to demonstrate the advantages of the use of cone valves for various services. ROTOVALVES have been developed in answer to a demand for a water controlling device which would employ the fundamental concept of the plug cock when coupled with new methods of operation and control. Their high quality is assured by the added advantages of being fabricated in modern



shops by skilled artisans on up-to-date machinery and of the finest materials.

More than 60 years of experience in the design and manufacture of large hydraulic equipment enables us to apply a vast fund of technical information to the solution of special hydraulic problems. We are prepared to meet situations necessitating special design and to assist in the solution of unusual and difficult installation requirements.



Smith Hydraulic Laboratory

MOST of the recent major advances in the art of designing various types of hydraulic equipment have come about as the direct result of painstaking research and laboratory experiments. Tests conducted in the Smith Hydraulic Laboratory have contributed in no small measure to this recognized progress. The large standpipe on the roof of the building was erected especially for the testing of cone valves. This feature when used in conjunction with the recirculatory pumping system provides constant quantities of water at predetermined adjustable pressures. As the result of this testing experience ROTOVALVES are designed to meet the most exacting requirements.

Bulletin No. 140

S. MORGAN SMITH COMPANY

YORK, PENNSYLVANIA

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